UNION SWITCH & SIGNAL
645 Russell Street
Batesburg, SC 29006

Service Manual 7063

Digitair® Model 6696

End-of-Train Communication Display Unit

Installation ■

Operation ■

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1.0 PURPOSE OF MANUAL

This manual provides general information on the DIGITAIR® End-of-Train Telemetry System and detailed information on the installation and operation of the Model 6696 Communication Display Unit (CDU). Refer to Service Manual SM 7064 for detailed Shop Maintenance information.

1.1 GENERAL OVERVIEW

The DIGITAIR® End-of-Train Telemetry System consists of a Communication Display Unit (CDU) mounted in the locomotive cab which communicates via UHF radio with an end-of-train End Unit mounted on the coupler of the last train car.

The CDU, when operating in conjunction with an End Unit such as the DIGITAIR® Model 6695 SBU, provides the locomotive operator with information about the conditions at the rear of the train that are important to the operation of the train. The CDU's major functions include:

- A digital display of the brake pipe pressure at the rear of the train.
- An indication of motion of the last car (moving/stopped) and its initial direction (forward/reverse).
- The End Unit battery status and other warnings about brake pipe pressure.
- The On/Off status of the Highly Visible Marker (HVM) light if equipped on the End Unit.
- When operating in two-way mode, provides an Emergency braking function from the rear of the train.

The CDU can be configured to support optional functions such as:

- A digital display of the auxiliary pressure if transmitted by dual pressure type End Units.
- A built-in odometer to display the distance traveled by the locomotive, speed, and/or acceleration.

The CDU Model 6696 is compatible with all End Units employing existing protocols such as the American Association of Railroads (AAR) End-of-Train message protocol. It meets or exceeds the guidelines of the AAR along with the Federal Railroad Administration (FRA), the Federal Communications Commission (FCC), Industry Canada (IC), and the Canadian Department of Communications (DOC) regulations.

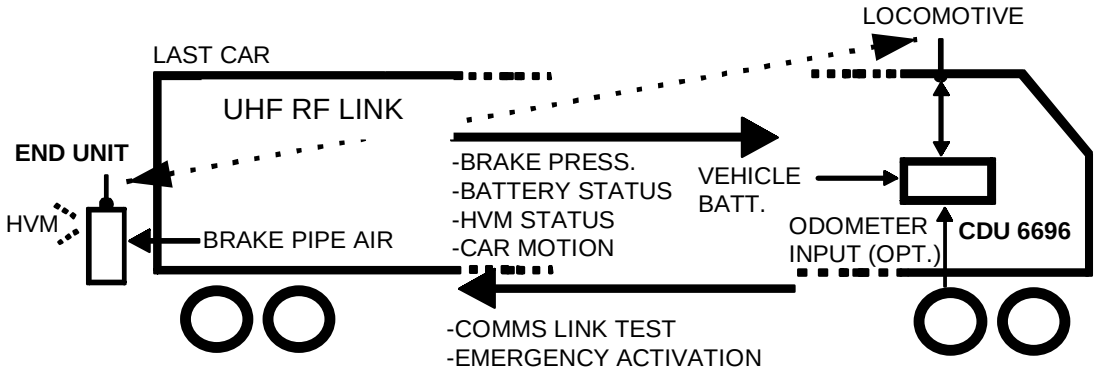


Figure 1-0. Two-Way Telemetry Functions

1.1.1 CDU FUNCTIONAL DESCRIPTION

The CDU mounts in the locomotive cab; it connects to an antenna mounted on the roof and to the DC power system (72 VDC nominal). Separate connectors are provided for connection to the locomotive Axle Alternator (odometer), a Datalogging device, and a Diagnostic computer.

Since the CDU incorporates all displays, the warning beeper, and all controls on its front panel, it should be mounted where it is highly visible and within easy reach of the locomotive operator (i.e., on the control stand or in a console).

The CDU transmits and receives data to/from the End Unit using a UHF radio transceiver. The transmitter frequency is typically 452.9375 MHz and the receiver frequency is typically 457.9375 MHz. When the CDU receives a message from the End Unit, it processes the information and displays it on various LED displays and annunciators. The CDU is typically in the receive mode of operation ready to accept and display messages from an End Unit. When the COMM ARM key or EMERGENCY switch is pressed, the CDU switches to transmit mode, sends the respective command message, and then immediately returns to receive mode.

If the optional Arming feature (a security function) is enabled in the CDU, the Emergency transmission is sent only if the CDU has been “Armed” to the ID code of its matched End Unit.

If the CDU is connected to the locomotive axle alternator, it can be configured for various odometer related functions. These include the capability to display the distance traveled by the locomotive, a train length function whereby the length of the train can be entered and stored and then be used as a preset distance counter, and the display of train speed and/or acceleration. The CDU has built-in functions to allow calibration of the odometer to compensate for locomotive wheel size variations. In addition, the CDU can be configured to display odometer measurements in English or Metric units. Refer to Section III for operating instructions.

An RS-232 serial port used for datalogger and event recorder functions is a standard feature of the CDU. Whenever new information appears on the display or a transmission is received from the End Unit, the data is transmitted to this port so that it may be stored in a computer, event recorder, or be directly printed.

The CDU also supports an RS-232 serial port for diagnostics, unit configuration, and download of software upgrades. These are all performed via a standard DOS-compatible personal computer (PC).

As an additional safety feature, the CDU also displays the status of the emergency brake valve drive circuitry used in the End Unit. It will show a “Valve Fail” alarm indication if a problem is detected.

1.2 DEFINITION of TERMS

The following terms and abbreviations are used throughout this manual:

EOT - End-of-Train: Refers to an End-of-Train telemetry system comprised of a Cab Unit mounted in the locomotive and an End Unit mounted on the coupler of the last train car.

CDU - Communication Display Unit: A two-way End-of-Train Cab Unit (e.g., CDU Model 6696).

SBU - Sense and Brake Unit - Any generic two-way End-of-Train End Unit capable of remote Emergency Brake Applications.

HVM - Highly Visible Marking Device - The Marker Light portion of the End Unit; an FRA approved flashing light used to mark the end of the train.

1.3 PATENTS AND TRADEMARKS

Patents have been granted or are pending on items described in this manual. In the USA, the following patents have been applied for or have been granted:

Railway Brake Pressure Monitor, Patent 4,487,060
Coupler Mount Assembly, Patent 4,520,662
Rechargeable Battery Pack, Patent 4,554,221

Similar patent applications have been made or are being made in Canada and Australia. DIGITAIR® is a registered trademark of Union Switch & Signal Inc.

1.4 R.A.I.L. TEAM AND TECHNICAL SUPPORT

The *Rapid Action Information Link (R.A.I.L.) Team* is comprised of a group of experienced product and application engineers ready to assist and resolve any technical issues concerning DIGITAIR® End-of-Train equipment or any US&S product.

Any questions regarding the contents of this Service Manual can be answered by contacting the R.A.I.L. Team toll free at 1-800-652-7276 or via Internet e-mail at: railteam@switch.com.

1.5 CDU ORDERING INFORMATION

The following ordering information can be used to select various configurations of the CDU Model 6696. Please contact US&S Customer Service at 1-800-652-7276 or your US&S Sales Representative for technical information, pricing, and additional sales information.

1.5.1 Mounting and Hardware Options

1. CDU Mounting Options:

   a) Standard Mounting Tray (Typically mounts on locomotive Control Stand)
   b) AAR Clean Cab Enclosure (Industry standard radio enclosure)
   c) Custom Mounts (per Railway requirements)

2. Connector Styles (Power and Axle Alternator):

   a) Bayonet Twist Lock (ITT Cannon)
   b) MS Threaded Style (Bendix/Amphenol)
   c) MS Bayonet Style (Bendix/Amphenol)

3. Front Panel “ARMED” Status LED Markings:

   a) No ARMED Status LED
   b) Status LED Marked “ARMED”
   c) Status LED Marked “NOT ARMED”

1.5.2 Parts Used for Installation

Table 1-1 below lists parts used for installation which may be ordered separately from the CDU.

Description	Part Number
Installation Kit Complete, Mounting Tray Style	X451646-9801
Installation Kit Complete, AAR Clean Cab Style	116-5016-00
CDU Mounting Tray	150-0128-00
CDU Odometer Cable	N451805-1201
CDU Power Cable, Bayonet Connector, 72 VDC	N451883-0401
CDU Power Cable, Bayonet Connector, 12 VDC	N451883-1401
CDU Antenna	472-0017-00
CDU Antenna Cable Kit	170-0842-00

Table 1-1. Installation Parts

1.5.3 Diagnostic Software Disk

The CDU does not rely on a dedicated external device for system diagnostics. All of the unit diagnostic tests and configuration functions are included on a Diagnostics Software Disk that runs on a standard DOS-compatible personal computer (PC) which plugs into the CDU's rear mounted Diagnostic Port.

The Diagnostic Software has been designed to permit easy customization of the operation of the CDU. Most of the variable default values and functions are user selectable, set by the factory at purchase time, or by railway technicians via a PC computer after purchase. The Diagnostic Software program on the disk is named **"diagunit.exe"** and its use is described in Sections IV.

The Diagnostic Software Disk can be ordered under the following part numbers:

Description	Part Number
3.5" Diskette	N451232-1264
5.25" Diskette	N451232-1265

Table 1-2. Diagnostic Software Diskette

1.5.4 CDU Executable Software Disk

The CDU uses a FLASH type programmable non-volatile memory chip to store its application software as opposed to a standard EPROM. This eliminates the need to disassemble the unit and physically replace the EPROM in the event that software upgrades are issued.

The CDU Executable Software disk allows the user to download CDU software upgrades into the CDU's internal FLASH memory. This disk contains two files; (1) the latest upgrade version of the CDU executable software named **"cdu.hex"**, and (2) the Cab Unit Flash Loader program named **"load.exe"**. The use of this disk is described in Appendix A.

The CDU Executable Software disk is available on a 3.5" diskette under US&S part number N451232-0821.

1.6 CDU SPECIFICATIONS

Parameter	Specification
Physical:	
Overall Dimensions	H = 4.25", W = 10.75", D = 8.25"
Weight	9 lbs
Environmental:	
Operating Temperature Range	0°C to +60°C
Storage Temperature Range	-55°C to +100°C
Humidity	95% non-condensing at 40° C, 96 hour exposure
Vibration - any axis, peak-to-peak	5 - 15 Hz: 0.5g; 15 - 500Hz: 3.0 g
Shock - (11 msec triangular, 3 planes)	20 g
Altitude	-300 to +15000 feet MSL
Power Requirements:	
72 VDC Locomotive Power, Floating	58 VDC (min); 72 VDC (nom); 86VDC (max)
Current Consumption @ 72 VDC	0.35 A (typ); 1.5 A (max)
13.6 VDC Power Input (Negative Ground)	13.6 VDC (min/nom); 14.3 (max)
Current Consumption @ 13.6 VDC	1.0 A (typ); 4.0 (max)
Radio Transceiver:	
Transmit Frequency	452.9375 MHz (AAR typ); 450 - 475 MHz (available)
Transmit Power	2 Watts (standard); 4 Watts (Configurable)
Transmit Frequency Stability	5 ppm
Emission	16K0F2D
Deviation (at 1200 Hz)	3.3 KHz
Receive Frequency	457.9375 MHz (AAR typ); 450 - 475 MHz (available)
Receive Sensitivity (-12 dB SINAD)	0.45 uV (max)
Receive Frequency Stability	10 ppm (max)
Selectivity	60 dB (min)
Intermodulation Immunity	60 dB (min)
Spurious Rejection	55 dB (min)
Image Rejection	50 dB (min)
Odometer Interface:	
Input from Axle Alternator	20 ppr or 60 ppr
Wheel Diameter Calibration Range	34.00" (min); 40.00" (default); 46.00" (max)
Datalogger Interface:	
Asynchronous Serial Data Rate	300 to 9600 Baud
Voltage Level	EIA RS-232C
Data Format	Configurable Parity, Stop Bits, and Data Bits
PC Diagnostic Interface:	
Asynchronous Serial Data Rate	9600 Baud, 1 Stop Bit, 8 Data Bits
Voltage Level	EIA RS-232C

Table 1-3. CDU Specifications

1.7 CDU MAJOR COMPONENTS

The photo and illustration below shows the CDU Model 6696 external components and typical front panel layout.

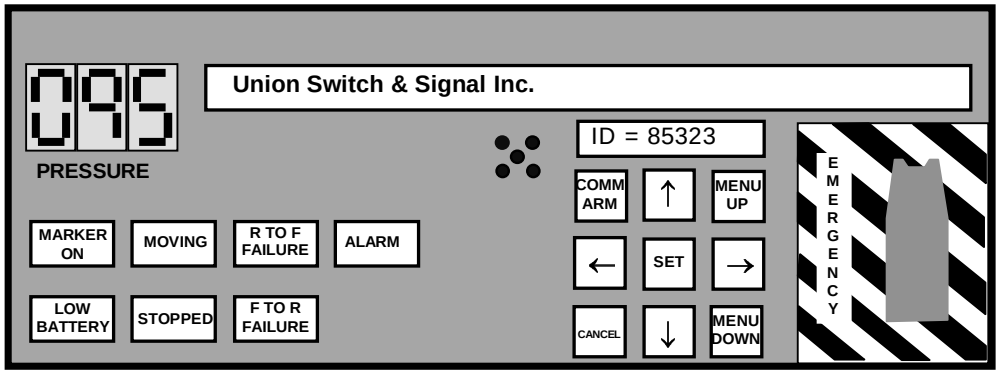


Figure 1-1. - Model 6696 CDU Features & Front Panel Layout

1.7.1 CDU Unit Housing

The CDU Model 6696 uses the same exterior aluminum alloy housing used on previous versions of DIGITAIR® Cab Units. This helps ensure the Model 6696 will fit into, and be compatible with, existing locomotive installations. Two mounting configurations are available; a Standard Mounting Tray style mount, and an AAR Clean Cab Enclosure style mount.

The CDU is designed to be lightweight (9 pounds) and incorporates a fold-out carrying handle for transporting the unit to the locomotive or between locomotives.

1.7.2 CDU Rear Panel

The photo below shows a typical rear panel connector layout for the CDU Model 6696.

Figure 1-2. Model 6696 CDU Features (Rear Panel View)

The CDU supports connectors on its rear panel for the following functions:

- **Power:** 72 VDC nominal locomotive power or 13.6 VDC nominal for mobile use.
- **Axle Alt.:** Connects to locomotive's axle alternator for Odometer related functions.
- **Antenna:** Connects to roof mounted locomotive UHF antenna.
- **Datalogger:** Can be interfaced to an event recorder, computer, or serial printer.
- **Diag:** Connects to a PC serial port for diagnostic and configuration purposes.

Mounting hardware on the rear panel includes:

- **Screw Latch:** Spring loaded latch secures the CDU to the Mounting Tray or AAR Clean Cab Enclosure.
- **Lock Bracket:** Provides a means for locking the CDU to the Mounting Tray using a padlock.

1.7.3 CDU Major Assemblies

The photo below shows a top view of the CDU with its cover removed exposing the major assemblies. The unit has been designed using a modular approach for ease of production and user maintenance.

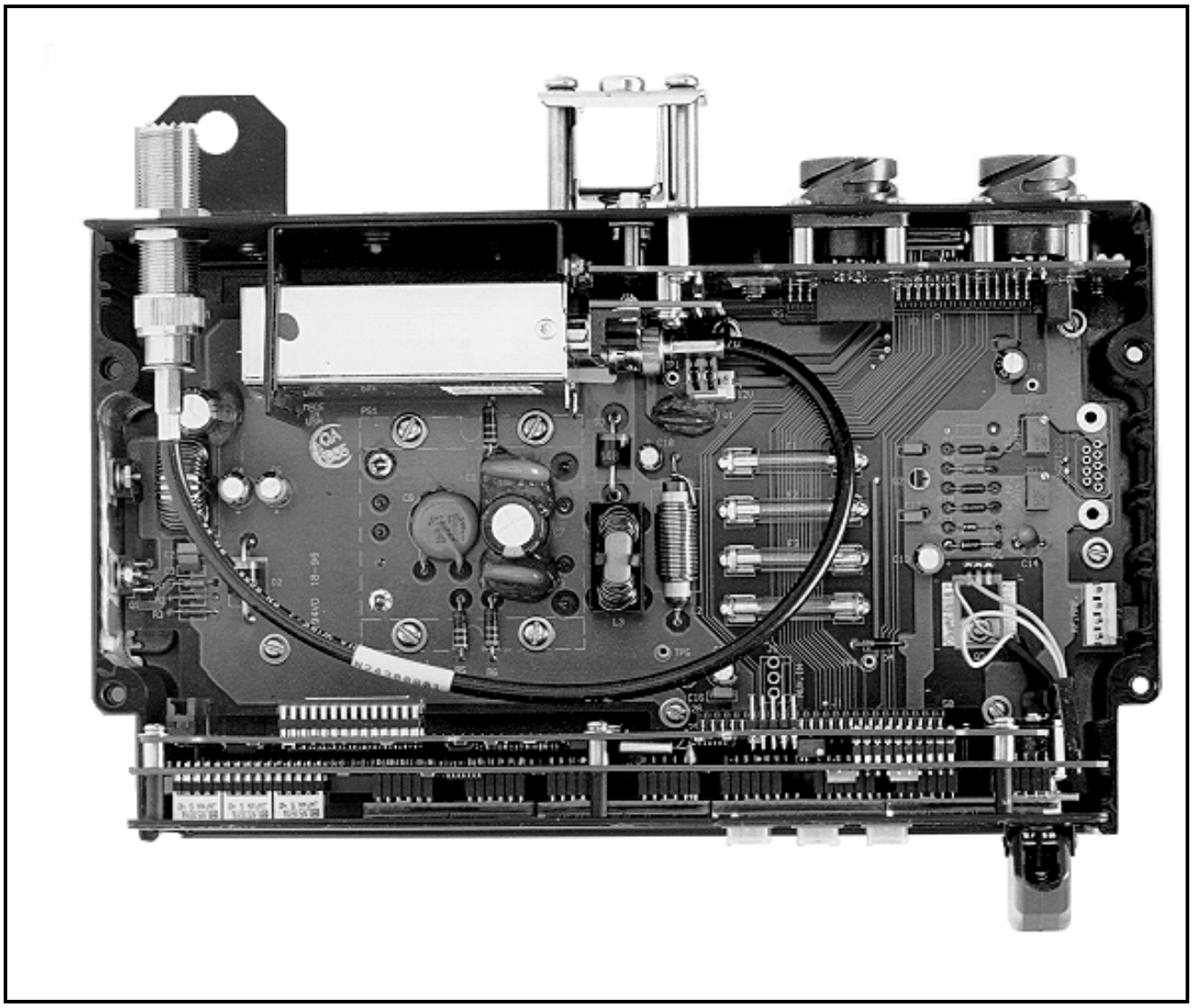


Figure 1-3. Model 6696 CDU Features (Top Internal View)

The CDU is comprised of the following three (3) major sub-assemblies:

- **Front Panel Assembly:** Contains the Processor Board, LED Display Driver Board, Display Panel, and Emergency Switch Assembly.
- **Rear Panel Assembly:** Contains the Interface Connectors and UHF Transceiver Module.
- **Base Assembly:** Contains the Bottom Housing, Power Supply Circuitry, and serves as the base into which the Front and Rear Panel Assembly plug.

1.8 CDU FUNCTIONAL BLOCK DIAGRAM

The following is a functional block diagram of the CDU Model 6696 showing its major sub-systems and external interfaces.

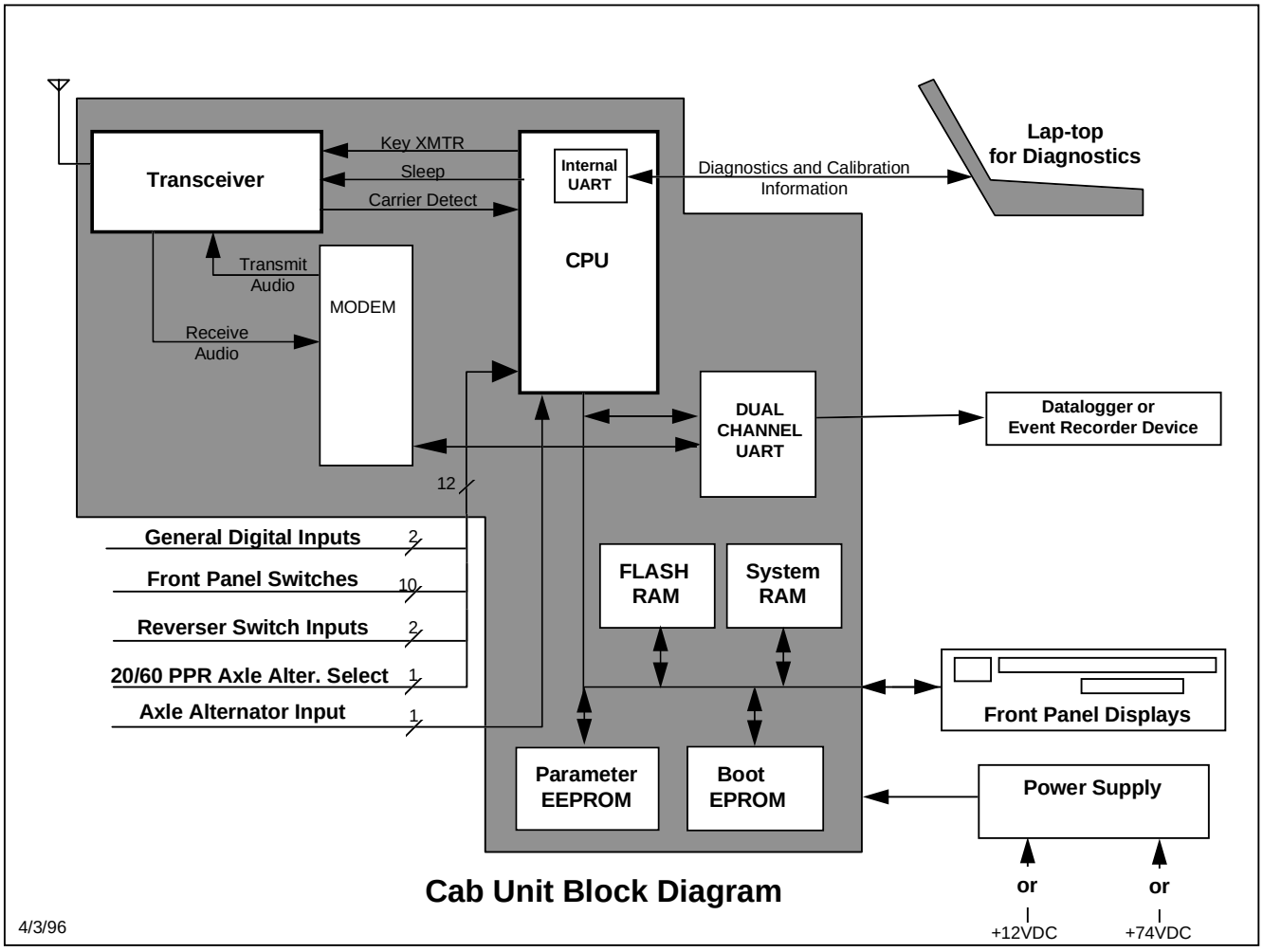


Figure 1-4. CDU Model 6696 Functional Block Diagram

2.0 INSTALLATION OF THE CDU

This section details the installation of a CDU into the locomotive cab environment. Two versions of CDU mounting arrangements are available:

1. CDU mounted on a Mounting Tray.
2. CDU mounted in an AAR Clean Cab Enclosure.

2.1 General Description

The locomotive equipment comprises a Model 6696 Communication Display Unit (CDU). Available accessories include (refer to Table 1.1 for part numbers):

- Complete Installation Kits
- Mounting Tray
- Antenna Cable Kit
- UHF Antenna
- Power Cable Assemblies
- Odometer Cable Assemblies
- Diagnostic Software Disk

The Power and Odometer cables may be purchased separately or fabricated by the Railroad.

The locomotive antenna and antenna cable may be purchased from US&S or supplied by the Railroad. The cable must employ a PL-259 style UHF connector. The antenna itself must be 1/4 wave whip or a low profile slot-type antenna.

If desired, the Railroad may supply a padlock to lock the CDU into position on the Mounting Tray.

2.2 Preparing the Locomotive

This section provides information on preparing a locomotive for installation of the CDU. Once the locomotive has been equipped as described in this section, the CDU may be installed as instructed in 2.4.

Preparing the locomotive involves equipping it with either a Mounting Tray or AAR Clean Cab Enclosure and wiring the required electrical connections. Note that some locomotives may already have this equipment installed.

2.2.1 Mounting Tray Installation

The Mounting Tray is typically located on the control stand and provides the CDU with a mechanical quick-disconnect base for easy application and removal. The Mounting Tray is affixed to the control stand as follows:

1. Using a Mounting Tray as a template, mark the control stand for drilling.

2. Drill holes of 1/4" diameter.

3. Attach the Mounting Tray to the control stand using appropriate bolts, nuts, and lockwashers (supplied by the Railway).

2.2.2 AAR Clean Cab Enclosure

Installation of an industry standard AAR Clean Cab Enclosure in the locomotive is the responsibility of the Railway.

2.3 Installing the CDU Cables

This section details the installation of the Power and Odometer cables required to connect the CDU to the locomotive. The cables and their respective part numbers are listed in Table 1-1 in the previous section.

2.3.1 Power Cable Installation

For most installations, one of two types of power cable assemblies are used to connect the CDU to the locomotive DC power system. One is a 5-pin Bayonet Twist Lock type (CA) connector and the other is a 4-pin MS Threaded type connector. In both cases, the cable assemblies are supplied with the connector pre-mounted on one end of the cable, with the other end left unterminated.

CAUTION

Non-standard cables, or those supplied by the Railroad, may employ different color codes than those used by US&S. Refer to the connector pin assignments in this manual or consult US&S Customer Service at 1-800-652-7276 for further technical assistance, if required.

Cut the cable to the desired length. Strip and install whatever spade lug, tab, or other contact is required for the locomotive. The three conductor cable should be wired per the table below:

Pin	Conductor	Bayonet (CA) Type Connector	MS Threaded Type Connector
A	Black	+ 72 VDC Locomotive Power	+ 72 VDC Locomotive Power
B	N.C.	+ 13.6 VDC Mobile Power	13.6 VDC Mobile Power Ground
C	White	72 VDC Locomotive Power Return	72 VDC Locomotive Power Return
D	N.C.	13.6 VDC Mobile Power Ground	+ 13.6 VDC Mobile Power
E	Green	Chassis	Not Used

Note: N.C. = Not Connected

Table 2-1. CDU Power Connections

2.3.2 Odometer (Axle Alternator) Cable Installation

Two standard Odometer Cables are available. Each consists of a dual twisted pair, individually shielded cable with either a 6-pin Bayonet Twist Lock type (CA) connector or 6-pin MS Threaded type connector on one end. The other end is unterminated.

CAUTION

Non-standard cables, or those supplied by the Railroad, may employ different color codes than those used by US&S. Refer to the connector pin assignments in this manual or consult US&S Customer Service at 1-800-652-7276 for further technical assistance, if required.

Cut the odometer cable to the desired length. Strip and install whatever spade lug, tab, or other contact is required for the locomotive. The shield wire(s) connects to the CDU chassis at the connector end; cut the shield wire(s) at the locomotive end and leave unconnected. The cables should be wired per the tables below.

For the Bayonet Twist Lock type (CA) connector, the pin assignments and cable color codes are:

Pin	Conductor	Bayonet Twist Lock Type (CA) Connector
A	RED-1	Axle Alternator Signal Input
B	RED-2	Direction A (TL8)
C	BLK-2	Direction B (TL9)
D	See notes *	20 / 60 PPR Return
E	See notes *	20 / 60 PPR Select
F	BLK-1	Axle Alternator Signal Return

Table 2-2. CDU Axle Alternator Connections (Bayonet Twist Lock Type Connector)

*** Notes:**

- PPR = Pulses Per Locomotive Wheel Revolution
- For 20 PPR operation, retain jumper between pins D and E.
- For 60 PPR operation, cut jumper between pins D and E.

For the MS Threaded type connector, the pin assignments and cable color codes are:

Pin	Conductor	MS Threaded Type Connector
A	RED-1	Axle Alternator Signal Input
B	BLK-1	Axle Alternator Signal Return
C	See notes *	20 / 60 PPR Select
D	See notes *	20 / 60 PPR Return
E	RED-2	Direction A (TL8)
F	BLK-2	Direction B (TL9)

Table 2-3. CDU Axle Alternator Connections (MS Threaded Type Connector)

*** Notes:**

- PPR = Pulses Per Locomotive Wheel Revolution
- For 20 PPR operation, retain jumper between pins C and D.
- For 60 PPR operation, cut jumper between pins C and D.

NOTE

When routing the odometer cable from the axle alternator to the CDU, ensure that it is kept clear of locomotive "dirty" (noisy) wiring.

2.3.3 Antenna and Cable Installation

Install the UHF antenna at least 6" from the edge of the locomotive roof and at least 12" from any other fixture on the roof. Try to keep the cable run as short as possible.

If interference from a nearby transmitting antenna (e.g. voice radio) is likely to be a problem, locate the antenna as far away as possible.

Affix the antenna cable in place and terminate it in a PL-259 UHF connector. Use only a high quality low loss antenna cable such as RG-213/U.

2.3.4 CDU Datalogger Connector

All CDUs are equipped with a DATALOGGER port connector. This is a 25-pin serial RS-232/C "D" type connector mounted on the rear panel. Four of the 25 pins are used as listed in the table below:

Pin	DATALOGGER Connector
1	Chassis Ground (Shield)
2	Receive Data (RX DATA)
3	Transmit Data (TX DATA)
7	Signal Ground

Table 2-4. CDU DATALOGGER Port Connections

The connector is designed to operate as a DCE type serial port where pin 2 is used to receive data from a remote serial device and pin 3 is used to transmit data to a remote serial device. This allows for the use of a "straight-through" (not a null modem) type serial cable.

Note that Chassis Ground and Signal Ground are isolated from each other. The serial communications parameters (baud rate, etc.) are configurable via a Diagnostic PC as described in Section IV of this manual.

2.3.5 Event Recorder Connector

For CDUs equipped with a circular Event Recorder connector, the connector pin assignments are as follows:

Pin	Event Recorder Connector
A	Receive Data (RX DATA)
B	Transmit Data (TX DATA)
C	Signal Common
D	Chassis (SHIELD)
E	Spare 1
F	Spare 2

Table 2-5. CDU Event Recorder Connections

2.4 MOUNTING THE CDU

This section details mounting the CDU onto the Mounting Tray or in the AAR Clean Cab Enclosure.

2.4.1 72 VDC / 12 VDC Power Selection Jumper (JP1)

The CDU can be powered from either the standard 72 VDC locomotive power system or a 13.6 VDC (nominal) power source such as an automobile lighter socket. An internal Power Selection Jumper (JP1) located on the Base Assembly allows the user to select one power source or the other.

The CDU is shipped with this jumper set to the 72V position.

To change the Power Selection Jumper setting, simply remove the CDU's top cover, remove the jumper plug, and place it in the desired position as marked on the PCB silk-screen. Replace the top cover.

2.4.2 Installing the CDU onto a Mounting Tray

CAUTION

Prior to connecting any cables to the CDU, it is recommended that the locomotive Radio Circuit Breaker be turned OFF.

a) Slide the CDU into the keyhole slots in the Mounting Tray.
b) Engage the screw latch at the rear of the CDU.
c) Tighten the screw latch until the CDU is firmly in place. Do not overtighten. Padlock the unit, if desired.
d) Connect the CDU Power cable to the power connector on the CDU.
e) If applicable, connect the CDU Odometer cable to the Axle Alt connector on the CDU.
f) If applicable, connect the CDU Datalogger/Event Recorder cable to the Datalogger/Event Recorder connector on the CDU.
g) Connect the Antenna cable to the mating RF connector on the CDU.

2.4.3 Installing the CDU into an AAR Clean Cab Enclosure

a) Slide the CDU into the enclosure from the back.
b) Engage the screw latch at the rear of the CDU.
c) Tighten the screw latch until the CDU is firmly in place. Do not overtighten.
d) Connect the CDU Power cable to the power connector on the CDU.
e) If applicable, connect the CDU Odometer cable to the Axle Alt connector on the CDU.
f) If applicable, connect the CDU Datalogger/Event Recorder cable to the Datalogger/Event Recorder connector on the CDU.
g) Connect the Antenna cable to the mating RF connector on the CDU.

2.5 BRIEF OPERATIONAL TEST OF THE CDU

Upon receipt of a new CDU, it is recommended that the unit be briefly tested as described in this section to verify correct operation. This is performed in conjunction with a known operational End Unit.

2.5.1 CDU Power-Up Sequence

Upon CDU power-up, verify that the following display sequence is indicated on the CDU's Front Panel:

- The 32-Character LED Display (**Function Menu Display**) shows **"Self Test in progress"** accompanied by a beep tone. All other displays should be off.
- The Brake Pressure Display shows three dashes **"- - -"**.
- The 8-character LED Display (**ID Code Display**) shows the currently stored End Unit ID code (e.g., **"ID=85323"**).
- The **Function Menu Display** continues showing the following message sequence:
  - **"Union Switch & Signal Inc."** (by default) or a customer specified character string.
  - **"Version: Revision X"**.
  - **"Boot PROM Version: REV X"**.
  - **"RAM test: passed"**.
  - **"ROM test: passed"**.
  - **"EEPROM test: passed"**.
  - **"USC test: passed"**.
  - **"Boot ROM test: passed"**.
  - **"Self Test Complete: passed"**.
- After completion of the above test sequence, the CDU reverts to its top (first) function menu item where the **Function Menu Display** shows (with the example ID code):

  " Change ID: 85323 "

  with the first digit flashing, ready for input by the operator.
- If a power-up diagnostic test fails, this will be indicated as such, and the power-up sequence will halt. Note the specific test that has failed and contact US&S Customer Service at 1-800-652-7276 for technical assistance or warranty repair instructions.

2.5.2 CDU Functional Check

Perform the following basic steps to verify that the CDU is functioning correctly:

- Obtain a known operational End Unit. It may be operated within the locomotive without damage and no pressurized air is necessary.

- Power-up the CDU, observe it completes its power-on sequence, and then enter the ID code of the End Unit into the CDU.

NOTE

If the CDU is configured to support the "Arming" security feature, it will prompt the user to perform the Arming process as described in Section III. IT IS NOT NECESSARY TO DO THIS IN ORDER TO PERFORM A FUNCTIONAL CHECK OF THE CDU.

- Press the external TEST button to activate the End Unit and cause it to transmit a message. Observe the Brake Pressure Display on the CDU. With no air pressure applied to the End Unit, the pressure reading should change from **"- - -"** to **" 0"** psi. This will be accompanied by a Low Pressure Alarm since the pressure is below the standard 45 psig threshold and is normal.

- Press the **COMM ARM** key on the CDU to initiate an RF link check. Observe the CDU's 32-character LED Display briefly shows **"WAITING FOR REPLY"**, shortly followed by **"COMM TEST OK"** . This confirms correct operation of the CDU's RF transceiver and associated control circuits.

  Note: The rightmost decimal point in the Brake Pressure Display serves as an indicator to show that a message has been received from the End Unit. It will briefly light each time a message is received.

- Verify the integrity of the Emergency Switch contacts by activating the switch and observing a **"SYSTEM IS NOT ARMED"** message on the Function Menu Display.

- Perform a **LAMP TEST** to verify that all of the LED display segments light. This is done by simultaneously pressing the **MENU UP** and **MENU DOWN** keys as marked on the front panel .

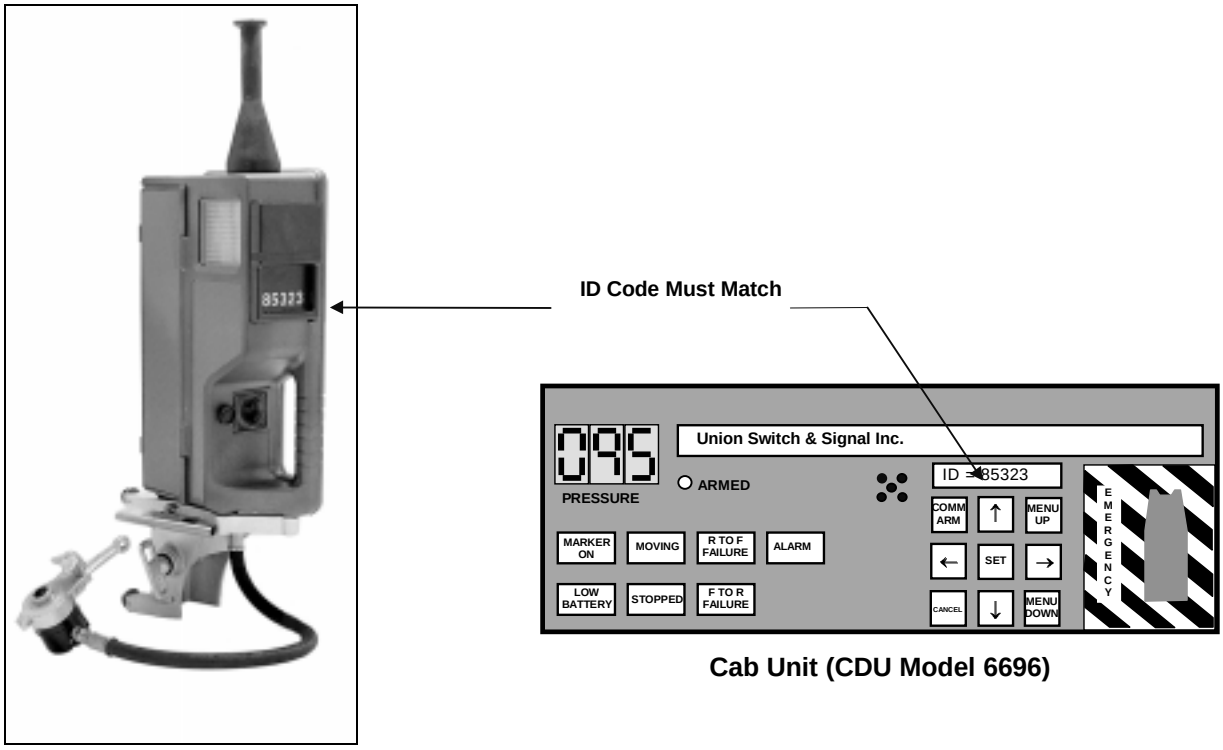
- Observe that each of the CDU's nine (9) Control Pushbuttons are illuminated (i.e., backlit).

3.0 CDU OPERATING INSTRUCTIONS

This section provides detailed information on the CDU's various operating modes and functions, and how each one is used.

3.1 Purpose and Use of ID Code

Each End Unit has a unique 5-digit numeric Identification Code (ID Code) assigned by the AAR "Central Train Information System Clearinghouse". The ID Code is programmed into each End Unit and is a part of every message it transmits. This code is permanently marked on a label or plate mounted on the outside of the End Unit. The ID code entered into the CDU must match the End Unit ID code before EOT messages can be received and displayed. Likewise, the End Unit will only accept and process commands from a CDU with the matching ID code.



Cab Unit (CDU Model 6696)

Typical End Unit

3.2 Radio Communication Channel

Since all End Units transmit on the same radio channel frequency (typically 457.9375 MHz), the ID code is the only way the CDU can distinguish one End Unit from another. In a similar fashion, all CDUs transmit on the same radio channel frequency (typically 452.9375 MHz) and the End Unit relies on the ID code to distinguish between commands sent by the CDU.

CAUTION

Ensure the ID code entered into the CDU matches that of the End Unit installed on the respective train before actuating the EMERGENCY switch.

With the correct ID code entered, the CDU is ready to begin receiving messages for display.

3.3 DESCRIPTION of CDU FRONT PANEL DISPLAYS and CONTROLS

All of the CDU Model 6696 operating displays and controls are located on the Front Panel and are arranged for easy use by the locomotive operator. Figure 3-1 below illustrates the CDU's front panel layout.

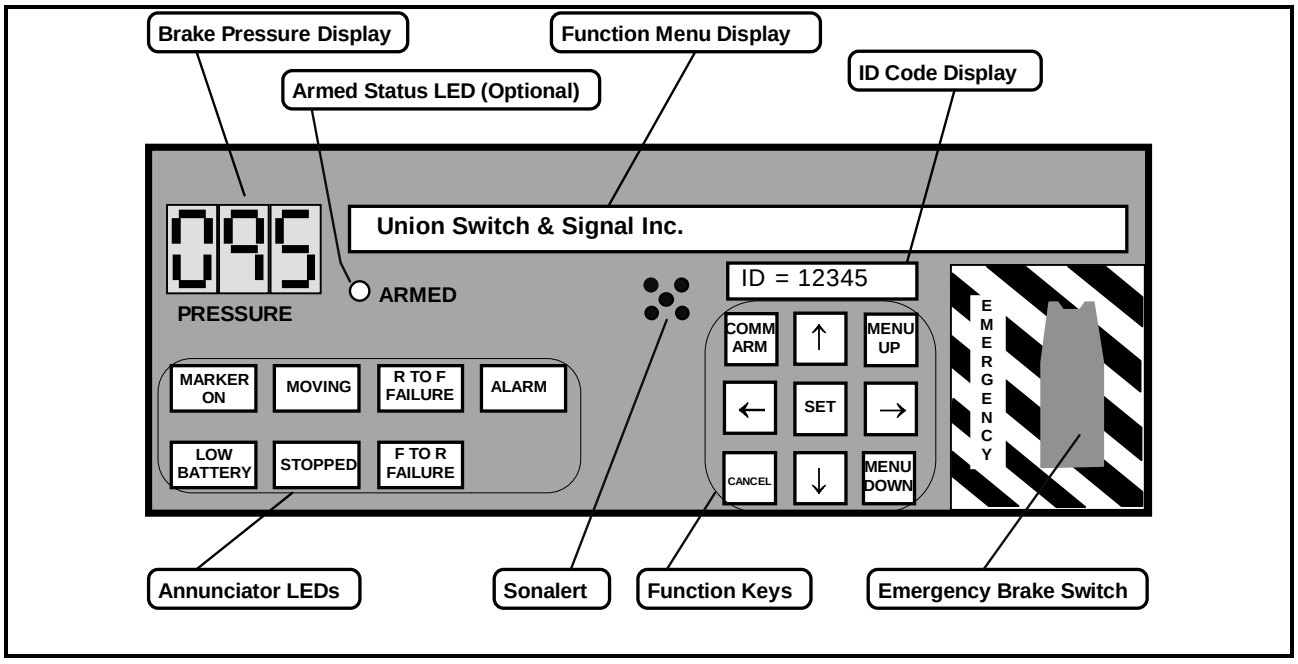


Figure 3-1. CDU Model 6696 Front Panel Layout

3.4 DESCRIPTION of CDU DISPLAY SYSTEM

The CDU front panel incorporates 5 display sections. These are the:

1. Brake Pressure Display and Integral Message Receipt Indicator
2. Function Menu Display
3. ID Code Display
4. Annunciator LEDs
5. ARMED Status LED (Optional)

3.4.1 Brake Pressure Display

This large 3-digit LED numeric display indicates the last valid brake pressure measurement received by the CDU. Brake pipe pressures ranging from 0 to 125 psig can be indicated to the nearest 1 psig.

The Brake Pressure Display will show three dashes **" - - - "** until a valid message is received. This indicates that the current pressure is unknown.

3.4.2 Message Receipt Indicator in Pressure Display

The right most decimal point in the Brake Pressure Display will blink ON briefly each time a valid message with the correct ID is received by the CDU. This indicator is provided as an aid to the operator in determining if messages are being received from the End Unit.

3.4.3 ID Code Display

The primary purpose of this 8-character alpha-numeric display is to indicate the currently entered EOT ID code.

This display also provides the operator with additional information regarding ALARM conditions and system operation. **When information other than the ID code is displayed, it is shown by alternating the display between the current ID code and the specific alarm or system function**. These messages include:

Alarm Messages:

- "LOW PRES" - The brake pipe pressure at the rear of the train has dropped below the low pressure threshold (typically 45 psig).
- "VALVFAIL" - The emergency brake valve drive circuitry in the End Unit may not be functional.
- "NO AIR" - The End Unit has just powered down due to 0 psig for greater than 5 minutes.
- "NOT ARMD" - The CDU has not been "Armed" to its respective End Unit.

System Information Messages:

- "FORWARD" - Displayed in conjunction with the **MOVING** annunciator to indicate that the initial direction of last train car is in the forward direction.
- "REVERSE" - Displayed in conjunction with the **MOVING** annunciator to indicate that the initial direction of last train car is in the reverse direction.
- "BATTWEAK"- Displayed in conjunction with the **LOW BATTERY** annunciator to indicate a weak battery condition in the End Unit.
- "REPLBATT" - Displayed in conjunction with the **LOW BATTERY** annunciator to indicate that the battery in the End Unit must be replaced at the next scheduled stop.

3.4.4 Function Menu Display

This 32-character alphanumeric display indicates the various menus items selected by pressing the **MENU UP** or **MENU DOWN** function keys. It is also used to display temporary information resulting from actions performed by the operator.

All of the menu items except "View and Change End Unit ID Code" can be enabled or disabled via configuration using the Diagnostic PC to accommodate Railway specific needs (these are all detailed in Section IV).

The table below lists the menu items in the order they are displayed with each press of the **MENU DOWN** function key when all menu items are enabled.

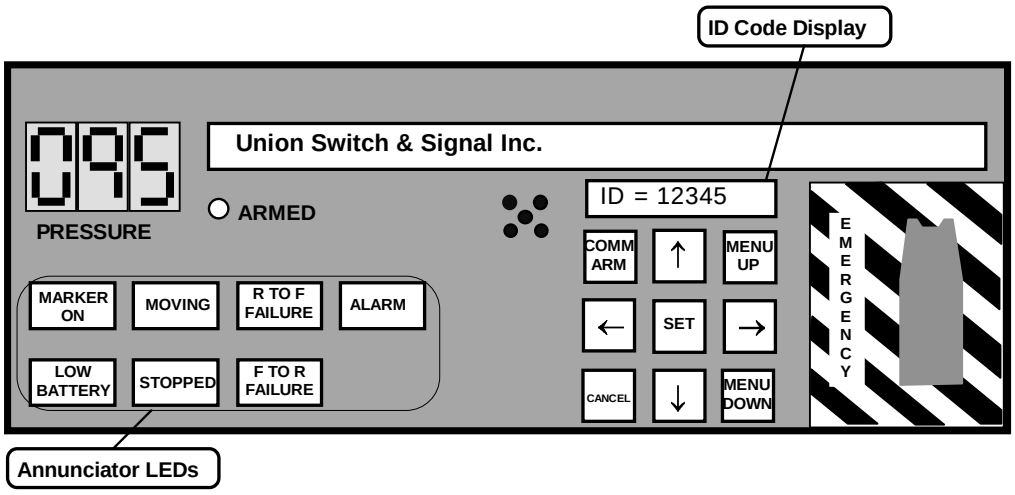
Menu Item	Functional Description	CDU Function Menu Display Messages	PC Configurable
1	View and Change the End Unit ID Code	**"Change ID: 12345"** **"Saving ID ..."** **"New ID: 12345"**	N
2	View Secondary Pressure	**"Secondary Pressure: 095"**	Y
3	View and Change the Train Length	**"Train Length: 02400 ft press SET"** **"New Train length: 03650 ft"**	Y
4	Measure Distance using the Odometer (count up from zero)	**"Odometer: press SET"** **"Odometer: 00000 ft"**	Y
5	Measure Distance using the Train Length (count down to zero)	**"TL Distance Countdown: press SET"** **"TL Distance = 03650 ft"**	Y
6	Calibrate the Odometer using a Measured Mile	**"Measured Mile: press SET"** **"Press SET at End of Mile 00000 ft"** **"4954 ft, corrected to 5280 ft"** **"Measured Mile FAILED"**	Y
7	View the Locomotive Wheel Size	**"Wheel Size = 40.00 inches"**	Y
8	Change Wheel Size	**"Wheel Size: 40.00" press SET"**	Y
9	View the Train Acceleration	**"Acceleration = 000 mph/min"**	Y
10	View the Train Speed	**"Speed = 000 mph"**	Y
11	"Disarm" from a Specified End Unit	**"Disarm: press SET"** **"Press SET to Confirm Disarm"** **"Disarming ... "** **"System is NOT ARMED"**	Y
12	View and Display All Incoming End Unit ID Codes	**"ID Scan: 12345 54321"**	Y
13	Set the Sonalert Output Volume	**"Change loudness: 4 (of 4)"**	Y
14	Set the Display Panel / Annunciator Brightness	**"Change brightness: 7 (of 7)"**	Y
15	Perform CDU Self Test	**"Self Test: press SET"** (Refer to Section 3.8.13)	Y

Table 3-1. Quick Reference: CDU Function Menus and Display Messages

3.4.5 LED Annunciators

A separate bank of seven (7) rectangular LED annunciators are provided to alert and draw the attention of the locomotive operator to important conditions. These are color coded Red or Green to indicate alarm or status conditions, respectively.

In the case where additional information about a particular annunciator is required, a corresponding message is displayed on the ID Code Display.



The table below provides a quick reference on the purpose of each Annunciator LED:

	Annunciator	Functional Description	Color
1	**MARKER ON**	Turns ON to indicate that the Marker Light on the End Unit is flashing.	Green
2	**LOW BATTERY**	Turns ON to indicate the existence of a low battery condition in the End Unit. The ID Code Display indicates if the alarm is a weak or replace battery condition.	Red
3	**MOVING**	Turns ON to indicate that motion has been sensed at the last train car. The ID Code Display indicates the initial direction as “Forward” or “Reverse”.	Green
4	**STOPPED**	Turns ON to indicate that the motion of the last car has stopped. Note: this LED is initially OFF until the last car begins to move and then comes to rest again.	Green
5	**R TO F FAILURE**	Turns ON to indicate the existence of a rear-to-front radio communications failure. When rear-to-front communications are restored, this LED will turn OFF.	Red
6	**F TO R FAILURE**	Turns ON to indicate the existence of a front-to-rear radio communications failure. When front-to-rear communications are restored, this LED will turn OFF.	Red
7	**ALARM**	Turns ON to indicate the existence of a system problem. The ID Code Display gives details on the nature of the Alarm. It is extinguished when the condition is corrected.	Red

Table 3-2. Quick Reference: CDU Annunciator LEDs

3.4.6 ARMED Status LED (Optional)

Three versions of the CDU front panel are available; (1) panel marked with **ARMED**, (2) panel marked with **NOT ARMED**, and (3) no marking (Armed Status LED not used). Depending on the version of front panel equipped on the CDU, this Green LED can be configured via the Diagnostic PC (see Section IV) to be turned ON or OFF as follows:

1. Front Panel Marked **ARMED**:

   In this case, the LED is configured to turn **ON** to indicate that the CDU has successfully completed the ARMING process. Its purpose is to provided the locomotive operator with a continuous positive indication that the Emergency Switch is enabled and ready for actuation, if necessary.

2. Front Panel Marked **NOT ARMED**:

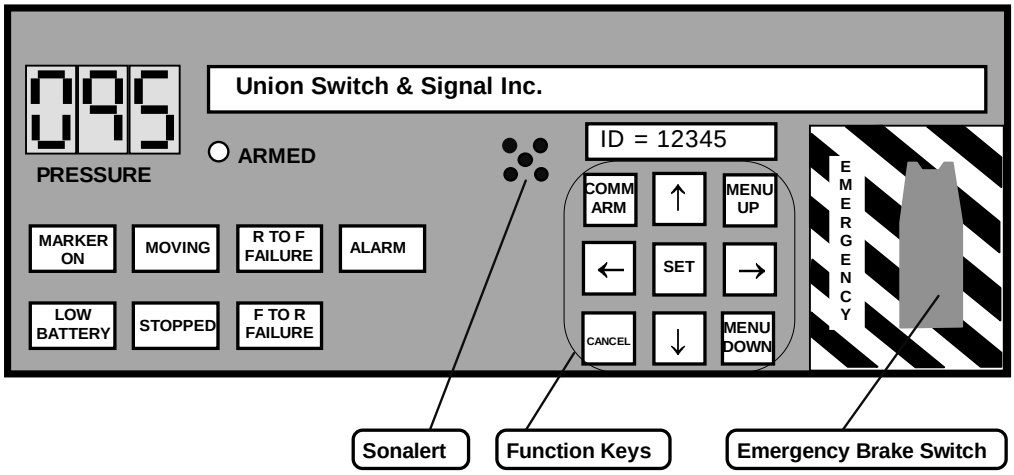
   In this case, the LED is configured to turn **OFF** when the CDU has successfully completed the Arming process. Prior to Arming, this LED will be ON to indicate that the CDU has NOT completed the ARMING process. Its purpose is to provided the locomotive operator with a continuous positive indication that the Emergency Switch is disabled and will NOT transmit an emergency brake command. The **ID Code Display**, as always, still shows **"NOT ARMD"** alternating with other information as a reminder that the CDU has not yet completed the Arming process.

3. Front Panel Not Marked (Armed Status LED not used):

   In this case, the panel area normally used for the Armed or Not Armed marking is blank. The LED is configured to be unused and will always be turned **OFF**. The **ID Code Display**, as always, still shows **"NOT ARMD"** alternating with other information as a reminder that the CDU has not yet completed the Arming process.

3.5 FUNCTION KEYS

The CDU Function Keys consist of nine (9) pushbuttons. These are illuminated ("back-lit") for readability at night. All CDU functions are performed using these keys.



The table below provides a quick reference on the purpose each Function Key:

	Function Key	Description of Operation
1	**MENU UP**	Selects the next menu item in ascending order
2	**MENU DOWN**	Selects the next menu item in descending order
3	"→"	Moves the "flashing selector" prompt for entry of numeric digits one position to the **right**. The selected active digit will flash.
4	"←"	Moves the "flashing selector" prompt for entry of numeric digits one position to the **left**. The selected active digit will flash.
5	" ↑ "	Increments the selected active digit by 1. If depressed for more than 1 second it continues to increase. Wrap around to 0 occurs after 9. This key is also used to increase the sonalert volume and front panel display brightness.
6	" ↓ "	Decreases the selected active digit by 1. If depressed for more than 1 second it continues to decrease. Wrap around to 9 occurs after 0. This key is also used to decrease the sonalert volume and front panel display brightness.
7	**SET**	Accepts the value on the display as the operator selected value.
8	**CANCEL**	Allows the operator to exit out of a menu item and return to the previously active menu item.
9	**COMM ARM**	Initiates a communications test and is also used to complete the Arming process with an End Unit.

Table 3-3. Quick Reference: CDU Function Keys

3.6 EMERGENCY BRAKE SWITCH

The **Emergency Brake Switch** is only operational if the CDU is operating in Two-Way mode and is “Armed” to the End Unit ID code being displayed in the **ID Code Display**.

When the operator flips this switch, the CDU transmits the emergency braking command to the End Unit. To help prevent unintentional activation, this switch is protected with a spring loaded RED switch guard forcing the user to consciously select it. The switch itself is also spring loaded to return to the "OFF" position when released.

3.7 SONALERT

The sonalert is used to alert and warn the locomotive operator of events or conditions needing attention, and to indicate successful completion of certain tasks.

To indicate the successful completion of a task, such as the successful entry of the ID code, the sonalert will beep once.

To indicate potential problems, such as an Alarm condition, the sonalert will beep five times.

The sound intensity of the sonalert is adjustable in four steps using the function menu item “Change Loudness: # (of 4)”. Note that on CDU power-up, the default loudness is always set to maximum.

3.8 OPERATION of CDU FUNCTION MENU ITEMS

This section provides a detailed description on the use each of the CDU's Function Menu Items. Use the **MENU UP** or **MENU DOWN** key to select the desired Function Menu Item, as required.

3.8.1 Viewing and Changing the ID Code

Many trains can exist in close proximity to one another, therefore each CDU/End Unit pair must have a way to identify messages that are coming from its "mated" unit. Sharing a unique ID code is how this is done. The End Unit is assigned a unique ID code during manufacturing which is stored in its parameter storage EEPROM. The CDU must be programmed with an ID code that matches that of the End Unit.

1. The **ID Code Display** shows the current ID code as follows:

   " ID = ##### "

   where ##### is the 5-digit ID code currently stored in the CDU's non-volatile (EEPROM) memory.

2. To change the ID code, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

   " Change ID: ##### "

   The ID code is changed by using the "→" or "←" keys to select the digit(s) to be modified. The current active digit flashes. Use the **" ↑ "** or **" ↓ "** keys to increment or decrement the selected active digit.

3. Once the desired ID code has been selected, press the **SET** key to store the new ID code. After pressing the **SET** key, the CDU will display:

   " Saving ... " followed by **" New ID: ##### "**

3.8.1.1 Operation if "Allow Changing Between One and Two Way ID Menu" is Enabled

If the Configuration Item entitled **"Allow Changing Between One and Two Way ID Menu"** is enabled, the CDU will prompt the user to switch from One or Two Way operation as follows:

1. Depending on the current operational mode (One-Way or Two-Way), the CDU will prompt the user in one of the following ways:

a) If the CDU is currently operating in **Two-Way mode**, the user is prompted as follows:

" Saving ... " followed by **" Press SET to change to One-Way "** followed by **" New ID: ##### "**

The **" Press SET to change to One-Way "** message is displayed for 5 seconds.

- If the **SET** key is NOT pressed during the 5 second window, the CDU will continue to operate in Two-Way mode and the sonalert will beep once to signal the successful completion of the save of the new ID into the CDU's parameter storage EEPROM.

If the CDU is configured to operate with the “Arming” security feature, the **ALARM** annunciator will flash ON accompanied by 5 beeps from the sonalert, and the **ID Code Display** will show:

" ID = ##### " alternating with **“ NOT ARMD”**

if the CDU has not yet been Armed to the new ID Code (See Section 3.10 - “Arming” process).

- If the **SET** key is pressed during the 5 second window, the CDU will switch to One-Way operation and the **Function Menu Display** will indicate:

" Changing mode ... " followed by **" Operation is now One-Way "**

In addition, the **ID Code Display** will continuously show:

" ID = ##### " alternating with **“ ONE-WAY”**

as a constant reminder to the locomotive operator that the CDU is in One-Way mode, and as such, its Emergency Switch is disabled.

When switching to One-Way mode, the **ALARM** annunciator will NOT flash ON since Arming does apply in One-Way mode.

b) If the CDU is currently operating in **One-Way mode**, the user is prompted as follows:

" Saving ... " followed by **“ Press SET to change to Two-Way “** followed by **" New ID: ##### "**

The **“ Press SET to change to Two-Way “** message is displayed for 5 seconds.

- If the **SET** key is NOT pressed during the 5 second window, the CDU will continue to operate in One-Way mode and the sonalert will beep once to signal the successful completion of the save of the new ID code into the CDU’s parameter storage EEPROM.

The **ID Code Display** will continue to show:

" ID = ##### " alternating with **“ ONE-WAY”**

as a constant reminder to the locomotive operator that the CDU is in One-Way mode, and as such, its Emergency Switch is disabled.

- If the **SET** key is pressed during the 5 second window, the CDU will switch to Two-Way operation and the **Function Menu Display** will indicate:

" Changing mode ... " followed by **" Operation is now Two-Way "**

If the CDU is configured to operate with the “Arming” security feature, the **ALARM** annunciator will flash ON accompanied by 5 beeps from the sonalert, and the **ID Code Display** will show:

" ID = ##### " alternating with **“ NOT ARMD”**

if the CDU has not yet been Armed to the new ID Code (See Section 3.10 - “Arming” process).

2. If the ID code digits have been changed but the **SET** key has not yet been pressed to store the new ID code, pressing the **CANCEL** key will cause the ID code to revert back to its original value.

3. Refer to Section 3.10 for a full description of the Arming process.

3.8.1.2 Operation of Change ID Code Display if "Blank ID Menu During No Activity" is Enabled

If the Configuration Item entitled **"Blank ID Menu During No Activity"** is enabled and none of the **Function Keys** are pressed for a period of 2 minutes, the CDU will display the currently entered Customer String (e.g., ABC Railroad) for 2 minutes and will then blank the **Function Menu Display**. This only applies to the Change ID Menu Item and has been provided to reduce distractions to the locomotive operator.

3.8.2 Entering the Train Length

Before the operator can make use of the Train Length Distance function, the current length of the train must first be entered. This is accomplished as follows.

1. To view the current train length or enter a new one, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

   " Change train length: ##### ft "

   where ##### is the current 5-digit value of the train length stored in the CDU's parameter storage EEPROM memory.

2. The train length is changed in the same manner as the ID code. Use the "→" or "←" keys to select the digit(s) to be modified. The current active digit flashes.

   Use the **" ↑ "** or **" ↓ "** keys to increment or decrement the selected active digit.

   Once the desired train length has been selected, press the **SET** key to store the new value. The sonalert will beep once to signal the successful completion of the save of the new train length into the CDU's parameter storage EEPROM. For example, if a train length of 3650 feet has been entered, the **Function Menu Display** will show:

   " New Train length: 03650 ft "

3. The units displayed (feet or meters) will be per the configuration selected via the Diagnostic PC as described in Section 3.8.9.1.

The Train Length Distance counter function is now ready for use.

3.8.3 Measuring Distance Traveled Using the Odometer (Count Up from Zero)

1. To use the Odometer, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

   “Odometer: press SET “

2. To measure distance, press the **SET** key. The **Function Menu Display** reads:

   “ Odometer: 00000 ft “

   The 5-digit count is initially set to zero and, as the train moves, it begins counting the distance as determined by the axle alternator pulses (20 or 60 ppr) and the state of the Reverser Handle.

   The Reverser Handle affects the Odometer count as follows:

   The initial position of the Reverser Handle defines the “positive” direction for the Odometer (i.e., movement in this direction will increment the displayed distance). If the Odometer count has started and the Reverser Handle is placed into the IDLE position permitting the train to "coast", this distance is included in the measurement. The distance traveled will continue to be accumulated until there have been NO pulses for 2 seconds (i.e., the train has stopped). If the Reverser Handle is then placed in the REVERSE position (i.e., the train is backing up), movement in this direction will decrement the displayed distance. At any point, the distance indicated on the display is the "net" distance traveled, allowing for backing up. Since there are only 5 digits in the display, it will roll over to 00000 after passing 99999.

   NOTE

   The CDU will NOT begin counting until it has sensed either the FORWARD or REVERSE direction signal at least once.

3. A second press of the **SET** key will “freeze” the display, indicating the net distance traveled. For example:

   “ Odometer: 02750 ft “

   but the counter will keep counting. Subsequent presses of the **SET** key will “unfreeze/freeze” the display until the function is terminated.

4. Press the **CANCEL** key to reset the Odometer function and restart from Step 1 above, or to terminate it and advance to another menu item.

5. If the **MENU UP** or **MENU DOWN** key is used to change from the Odometer function to another menu item function before the measurement is complete, the measurement will continue and the correct distance will be displayed when the operator returns to the Odometer menu.

6. The units displayed (feet or meters) will be per the configuration selected via the Diagnostic PC.

   NOTE

   Before the odometer measurement can be considered valid, the CDU must be calibrated using the Measured Mile method or by direct entry of the wheel size through the use of the Diagnostic PC.

3.8.4 Using the Train Length Distance Function (Count Down to Zero)

Since a train can approach 2 miles in length, it is not always practical for the locomotive operator to single-handedly determine if the rear end of the train has cleared a siding entrance or track junction so that it will not interfere with the passage of another train or highway traffic. The Train Length Distance function simplifies this task by indicating when the entire train has moved past a given point and how much clearance there is behind the train.

1. To use the train length function, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

   " TL Distance: press SET "

   where, 'TL' refers to 'Train Length'.

2. The locomotive operator now positions the front of the train at the junction or switch and presses the **SET** button. The **Function Menu Display** reads:

   " TL Distance = ##### ft "

   where ##### is the current length of the train in the currently configured units (feet or meters).

   As the train proceeds past the initial starting point, the displayed length will <u>decrement</u> in accordance with the distance being covered. The display will always indicate the "distance to go" before the end of the train is clear of the point of interest.

   Similar to the odometer mode, the distance displayed takes into account the state of the Reverser Handle, so that at any point, the distance indicated on the display is the "net" distance traveled.

3. When the count reaches **00000**, the end of the train has reached the point where the locomotive was when the function started. The sonalert will beep once to indicate that the calculated clearance point has been reached. As the train proceeds past this point, the display begins to increment again with a leading minus " - " sign to indicate the <u>clearance distance</u> between the end of the train and the measuring point. The **Function Menu Display** reads:

   " TL Distance = - ##### ft "

4. Subsequent presses of the **SET** key will "freeze/unfreeze" the display but the counter will keep counting until the function is terminated using the **CANCEL** key.

5. Press the **CANCEL** key to reset the Train Length Distance function and restart from Step 1 above, or to terminate it and advance to another menu item.

6. If the **MENU UP** or **MENU DOWN** key is used to change from the Train Length function to another menu function before the measurement is complete, the measurement will continue and the correct distance will be displayed when the operator returns to the Train Length menu.

NOTE

Before the Train Length measurement can be considered valid, the CDU <u>must</u> be calibrated using the Measured Mile method or by direct entry of the wheel size through the use of the Diagnostic PC.

3.8.5 Calibrating the Odometer Using a Measured Mile

Calibration of the Odometer is used to compensate for locomotive wheel wear and differences in wheel diameter from one locomotive to another.

The allowable range of locomotive wheel diameters is 34.00 inches through 46.00 inches. The CDU's default value is 40.00 inches.

Calibration of the wheel diameter can be done in one of two ways:

- Direct Entry though the use of the Diagnostic PC (see Section IV).
- Through the use of the odometer while traveling past measured mile markers along the track.

This section describes odometer calibration using a measured mile.

1. To calibrate using a measured mile, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

   " Measured Mile: press SET "

   When the "Zero Mile" marker is passed, press the **SET** key to begin the measurement. The pulses from the axle alternator are converted into a distance based on the current calibration value. The **Function Menu Display** reads:

   " Press SET at End of Mile #### ft "

   where #### is the incremental 4-digit count of the distance traveled in the currently configured units (mile or kilometer) as the train moves through the measured mile (or measured kilometer).

2. When the "One Mile" marker is reached, press the **SET** key a second time to mark the end of the mile and to calculate the new wheel size.

3. If the measurement is such that the calculated wheel size falls within the permitted range, the calibration passes and the sonalert will beep once to indicate that the measurement is complete.

   For example, the **Function Menu Display** reads:

   " 4954 ft, corrected to 5280 ft "

   The newly calculated wheel size is stored in the CDU's parameter storage EEPROM.

4. However, if the measurement is such that the calculated wheel size falls outside of the permitted range, the calibration fails, the sonalert will beep once, and the **Function Menu Display** reads:

   " Measured Mile FAILED "

   In this case, the currently stored wheel diameter is retained.

3.8.6 Viewing the Locomotive Wheel Size

To view the currently stored wheel size (diameter), press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

" Wheel Size = ##.## inches "

where ##.## is the calculated locomotive wheel diameter based on the measured mile calculation or the value entered using the Diagnostic PC.

The allowable wheel diameter range is 34.00 inches through 46.00 inches. The CDU is shipped with a default value of 40.00 inches.

If the CDU is configured for Metric Units, the wheel size is displayed in millimeters (mm).

3.8.7 Changing the Locomotive Wheel Size from the Front Panel

If the Configuration Item entitled **"Enable Change Wheel Size Menu Item"** is enabled, the locomotive wheel size can be entered and stored using the **Function Keys** in a manner identical to changing the ID Code.

To change the locomotive wheel size (diameter), press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

" Wheel Size: ##.## " press SET"

where ##.## is the locomotive wheel diameter.

After pressing **SET**, the CDU will display:

" New Wheel Size: ##.## " "

The allowable wheel diameter range is 34.00 inches through 46.00 inches. The CDU is shipped with a default value of 40.00 inches. If a value outside this range is entered, the CDU will revert to the currently stored value.

If the CDU is configured for Metric Units, the wheel size is displayed in millimeters (mm).

3.8.8 Viewing Train Acceleration

To view train acceleration, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

" Acceleration = ### mph/min "

where ### is the acceleration value in miles per hour per minute. Negative values indicate deceleration.

If the CDU is configured for Metric Units, the Train Acceleration is displayed in kilometers per hour per minute (kph/min).

NOTE

Before Train Acceleration values can be considered valid, the CDU must be calibrated using the Measured Mile method or by direct entry of the wheel size through the use of the Diagnostic PC.

3.8.9 Viewing the Train Speed

To view train speed, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

" Speed = ### mph "

where ### is the speed value in miles per hour. If the CDU is configured for Metric Units, the Train Speed is displayed in kilometers per hour (kph).

NOTE

Before the Train Speed can be considered valid, the CDU must be calibrated using the Measured Mile method or by direct entry of the wheel size through the use of the Diagnostic PC.

3.8.9.1 Setting and Using English or Metric Units

The Diagnostic PC can be used to configure the CDU to operate in either English or Metric units (see Section IV). This applies to all odometer related functions as follows:

Odometer Function	English Units	Metric Units
Measured Mile Calibration	Feet (ft)	Meters (m)
Wheel Size	Inches	Millimeters (mm)
Odometer Distance	Feet (ft)	Meters (m)
Enter Train Length	Feet (ft)	Meters (m)
Train Length Distance	Feet (ft)	Meters (m)
Acceleration	Miles / Hour / Minute (mph/min)	Kilometers / Hour / Minute (kph/min)
Speed	Miles / Hour (mph)	Kilometers / Hour (kph)

Table 3-4. English or Metric Units

3.8.10 Display Secondary Air Pressure

This function is made available for railways using dual pressure type End Units. It provides a secondary display of the air pressure for the auxiliary pressure source.

To display the Secondary Air Pressure, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

" Secondary Pressure: ### "

where ### is the 3-digit numeric value of the air pressure. This value will indicate **" - - - "** prior to reception of a message from the End Unit indicating that the pressure is not yet known.

3.8.11 Disarming the CDU

When a CDU/End Unit pair are “broken up” (i.e., when the End Unit is moved from one train to another), it is desirable to "Disarm" the CDU so that it no longer has Emergency Brake control of the End Unit that is on the other train. This can be done in the following two ways:

Method 1: Arming to “00000”

1. This method requires the operator to enter an ID code of "00000" in the same manner as described Section 3.8.1. This is a reserved ID code used only for disarming purposes.

2. When the operator presses the **SET** key, the currently displayed ID code in the parameter storage EEPROM is replaced with "00000".

3. Once the “00000” have been entered and saved, press the **COMM ARM** key. This will cause the CDU to extinguish the “NOT ARMD” alarm indication and, in effect, Arm to ID code “00000”. Note that if the CDU is configured for Automatic Arming, it cannot be Armed to “00000”.

Method 2: Using the Disarming Menu Function

1. The preferred method for disarming the CDU is to use the built-in Disarming Menu Function. This is selected by pressing the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

" Disarm: press SET "

2. When the **SET** key is pressed, the CDU prompts the operator to confirm the Disarming process as follows:

" Press SET to Confirm Disarm "

3. When **SET** key is pressed again, the CDU begins disarming itself and **Function Menu Display** briefly reads:

" Disarming ... "

4. Upon completion of the disarming process, the **Function Menu Display** indicates:

" System is NOT ARMED "

The **ALARM** indicator will flash ON accompanied by 5 beeps from the sonalert, and the **ID Code Display** will alternate between:

“ ID = 00000 “ and **“ NOT ARMD ”**

This indicates that the CDU is no longer Armed and its ID code has been set to “00000”. In addition, the ARMED Status LED, if equipped on the front panel, will turn OFF (for panels marked with ARMED), or turn ON (for panels marked with NOT ARMED).

3.8.12 Scanning for Incoming ID Codes

The CDU has the capability to display the ID code portion of all uncorrupted messages it receives.

1. To view incoming End Unit ID codes, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

   " ID Scan: ##### ##### ##### "

   where ##### are incoming End Unit ID codes.

2. Each End Unit ID code is displayed for a minimum of 5 seconds. If more than one ID code is received during this 5 second period, each new ID code is displayed separated by a space from the one preceding it.

3. If the message display becomes filled, each new ID code will overwrite the oldest displayed ID.

4. This is a configurable item via the Diagnostic PC and would typically not be used in the Cab but more likely by supervisors or dispatchers. It is factory configured to be OFF to minimize the confusion to locomotive operators. Note that the ID Scan function cannot be enabled if the CDU is configured for Automatic Arming.

3.8.13 Setting the Sonalert Output Volume

The sound level of the sonalert beeper is adjustable in four (4) steps to suit the individual locomotive operator.

1. To adjust the sound level, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

   " Change loudness: # (of 4) "

   where # is the current volume level out of a total of four.

2. To change the sound level, press the **" ↑ "** or **" ↓ "** keys to raise or lower the output volume, respectively. The sonalert will beep once for each key press at the indicated sound level. On power-up, the CDU always defaults to the maximum volume level (setting 4).

3.8.14 Setting the Display Panel Brightness

The brightness of the LEDs comprising the CDU Front Panel are adjustable in seven (7) steps to allow the locomotive operator to compensate for different ambient light levels.

1. To adjust the display brightness, press the **MENU UP** or **MENU DOWN** key until the **Function Menu Display** reads:

   " Change brightness: # (of 7) "

   where # is the current brightness level out of a total of seven.

2. To change the brightness level, press the **" ↑ "** or **" ↓ "** keys to increase or decrease the LED brightness, respectively, On power-up, the CDU always defaults to the maximum brightness level (setting 7).

3.8.15 Performing a CDU Self Test

This function allows the locomotive operator to repeat the CDU power-on self test without having to power the unit OFF and back ON.

1. To select the Self Test function, press the **MENU UP** or **MENU DOWN** key until **the Function Menu Display** reads:

"Self Test: press SET "

2. The **Function Menu Display** will show the following test sequence:

- **"Self Test in progress"**
- **"Union Switch & Signal Inc."** (by default) or a customer specified character string.
- **"Version: Revision X"**.
- **"Boot PROM Version: REV X"**.
- **"RAM test: passed"**.
- **"ROM test: passed"**.
- **"EEPROM test: passed"**.
- **"USC test: passed"**.
- **"Boot ROM test: passed"**.
- **"Self Test Complete: passed"**.

In the event that a test item has failed, this will be indicated as such, and can be noted and used by the locomotive operator to inform shop maintenance personnel.

3.9 PERFORMING A LAMP TEST

To perform a Lamp Test, press the **MENU UP** and **MENU DOWN** keys simultaneously as indicated on the front panel artwork. While the 2 keys are pressed, all LED annunciators and all LED display segments will light to the level determined by the current brightness setting.

3.10 ARMING the CDU to an END UNIT

If the CDU is operating in the two-way mode and is configured to use the “Arming” security feature, it is necessary to first "authorize" the CDU to "talk to" the End Unit. This helps prevent undesired external devices or people from intentionally or unintentionally activating the emergency braking function. This process is called "Arming". An unauthorized or “unarmed” CDU can perform a Communications Link Test with a End Unit but is not permitted to initiate an emergency braking command (i.e., its Emergency Switch is disabled). Only after “Arming”, is an ID code considered to be an "AUTHORIZED" ID Code. The figure below illustrates the Arming process.

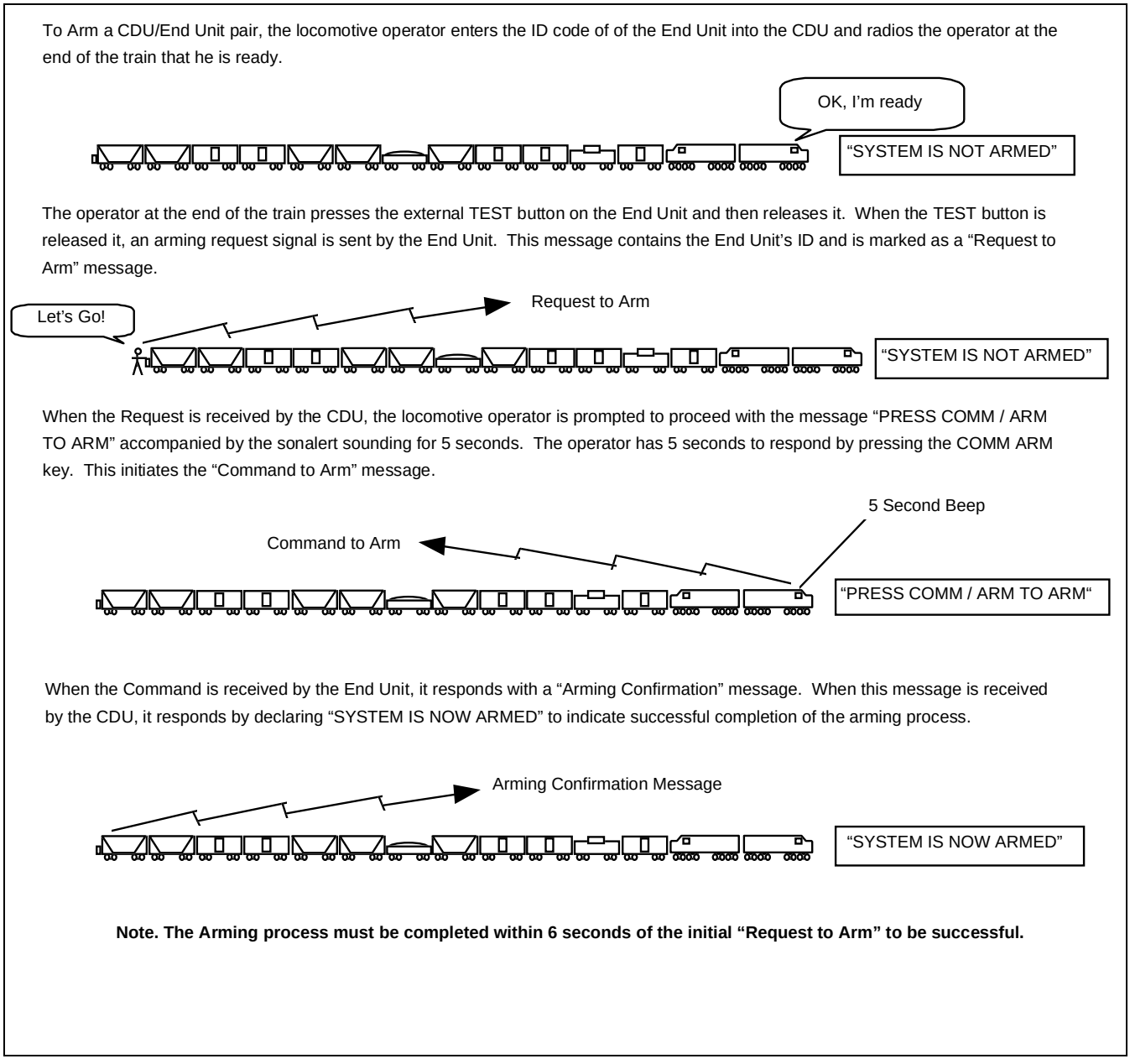

To Arm a CDU/End Unit pair, the locomotive operator enters the ID code of of the End Unit into the CDU and radios the operator at the end of the train that he is ready.
OK, I’m ready
“SYSTEM IS NOT ARMED”
The operator at the end of the train presses the external TEST button on the End Unit and then releases it. When the TEST button is released it, an arming request signal is sent by the End Unit. This message contains the End Unit’s ID and is marked as a “Request to Arm” message.
Let’s Go!
Request to Arm
“SYSTEM IS NOT ARMED”
When the Request is received by the CDU, the locomotive operator is prompted to proceed with the message “PRESS COMM / ARM TO ARM” accompanied by the sonalert sounding for 5 seconds. The operator has 5 seconds to respond by pressing the COMM ARM key. This initiates the “Command to Arm” message.
5 Second Beep
Command to Arm
“PRESS COMM / ARM TO ARM“
When the Command is received by the End Unit, it responds with a “Arming Confirmation” message. When this message is received by the CDU, it responds by declaring “SYSTEM IS NOW ARMED” to indicate successful completion of the arming process.
Arming Confirmation Message
“SYSTEM IS NOW ARMED”
Note. The Arming process must be completed within 6 seconds of the initial “Request to Arm” to be successful.

Figure 3-2. Arming Process

3.10.1 Description of Arming Process

1. The operator at the end of the train relays the End Unit ID code to the locomotive operator via voice radio.

2. The locomotive operator enters the ID code of the End Unit into the CDU (see Viewing and Changing the ID Code, Section 3.8.1).

   If the CDU has been “disarmed” or is not armed to the new ID code, the **ALARM** annunciator will flash ON accompanied by 5 beeps from the sonalert, and the **ID Code Display** will alternate between:

   " ID = ##### " and **“ NOT ARMD”**

   In addition, the **Function Menu Display** reads:

   " System is NOT ARMED "

3. The locomotive operator then alerts the operator at the end of train via voice radio to proceed with Arming. The operator at the rear of the train momentarily presses the TEST button on the End Unit. This causes a "Request to Arm Message" message containing the End Unit’s ID code to be transmitted to the CDU.

4. When the CDU receives the "Request to Arm Message" it prompts the Cab operator for a response. The **Function Menu Display** reads:

   " PRESS COMM / ARM TO ARM "

   for FIVE seconds accompanied by beeps from the sonalert.

5. If the locomotive operator presses the **SET** key during the 5 second window, a "Command to Arm” message is transmitted to the End Unit. When the End Unit receives the "Command to Arm” message, it responds by transmitting an "Arming Confirmation” message back the CDU. The CDU will then briefly display:

   " SYSTEM IS NOW ARMED "

   completing the Arming process. The “NOT ARMD” ALARM indication will turn OFF. The optional ARMED Status LED will light, if equipped on the CDU front panel.

The CDU is now authorized to execute an Emergency Brake Command, if required.

6. If the **SET** key is not pressed during the 5 second window, or if the End Unit doesn’t respond as described above, the **Function Menu Display** will briefly show:

   “ ARMING FAILED "

   In this case, the process must be repeated from Step 3 above.

3.10.2 Automatic Arming

Not all railroads elect to use the relative security provided by the Arming technique. They may choose to use "Automatic Arming" instead. In this case, the CDU is always Armed to the entered ID code, the Emergency Switch is always enabled, and there is no need for an operator at the rear of the train.

This feature is configurable via the Diagnostic PC (see Section IV). When the Automatic Arming function is enabled, the Scan ID function is locked out cannot be enabled.

3.11 MOTION INDICATION

The state of motion of the last train car is indicated on the CDU Front Panel by the **MOVING** and **STOPPED** annunciators. If the End Unit has the capability to sense the initial direction of motion, this is displayed on the **ID Code Display** as **"FORWARD"** or **"REVERSE"**.

1. From CDU power-up both the **MOVING** and **STOPPED** annunciators remain OFF until the last train car begins to move. From then on, one or the other will always be lit to indicate the state of motion of the last train car.

2. If the last car initially begins to move forward, the End Unit sends a message indicating forward motion. When the message is received by the CDU, the **MOVING** annunciator turns ON and the **ID Code Display** flashes:

   " FORWARD "

   for 10 seconds, then continues to steadily display "FORWARD" for another 10 seconds. This will alternate with other information being displayed such as "ID = #####" or one of the ALARM messages.

3. If the last car initially begins to move backward, the End Unit sends a message indicating reverse motion. When the message is received by the CDU, the **MOVING** annunciator turns ON and the **ID Code Display** shows:

   " REVERSE "

   for 10 seconds, then continues to steadily display "REVERSE" for another 10 seconds. This will alternate with other information being displayed such as "ID = #####" or one of the ALARM messages.

4. When the last car of the train comes to rest, the End Unit sends a message indicating no motion. When the message is received by the CDU, the **STOPPED** annunciator turns ON and stays ON until movement at the rear of the train is again detected.

   If the **STOPPED** annunciator lights during the indication of "FORWARD" or "REVERSE" (i.e., train moves and then very shortly stops), the directional information will immediately extinguish.

3.12 ALARM INDICATIONS

The CDU incorporates 4 dedicated RED annunciators in conjunction with messages displayed on the ID Code Display to present alarm conditions to the locomotive operator. These operate as described in the following paragraphs.

3.12.1 Low Battery

The **LOW BATTERY** annunciator turns ON to indicate the existence of a low battery capacity condition in the End Unit. The **ID Code Display** indicates if the alarm is a weak or replace battery condition and will alternate with other information already being displayed such as the current ID code.

To gain attention from the locomotive operator, when a low battery condition is first sensed, the **LOW BATTERY** annunciator will flash 5 times accompanied by beeps from the sonalert. The **ID Code Display** will also flash:

"WEAKBATT" or **"REPLBATT"**

to indicate a weak or replace battery condition, respectively.

The **LOW BATTERY** annunciator will then stay ON until the battery in the End Unit has been replaced. The "WEAKBATT" and "REPLBATT" messages will continue to be shown on the ID Code Display and will alternate with other information already being displayed. These messages will extinguish once the End Unit Battery has been replaced.

A weak battery condition indicates that there are several hours of operating life remaining in the battery, depending on the condition of the battery itself, the number of radio transmissions occurring, temperature, and ambient light conditions (i.e., duration that the HVM light is flashing). This indication serves as a warning that a charged battery is required.

A replace battery condition indicates that there is very little battery capacity left and that the End Unit may not continue to operate until the next scheduled stop.

NOTE

If the battery is unable to maintain End Unit operation, a communications failure ALARM will result.

3.12.2 Rear-to-Front Communications Failure (R TO F FAILURE)

If no messages are received from the End Unit for a period of approximately 5 minutes 41 seconds, the CDU will flash the **R TO F FAILURE** annunciator 5 times accompanied by beeps from the sonalert and then remain ON. The **Brake Pressure Display** will indicate 3 dashes **" - - - "** since the pressure reading is now unknown.

The **R TO F FAILURE** annunciator will remain lit until a valid message is received from the matching End Unit. As soon a message is received, the alarm will be reset and the annunciator will turn OFF.

Note, Rear-to-Front Communications problems may be caused by:

- Long tunnels
- Wrong ID Code entered into the CDU
- Discharged battery in the End Unit
- Faulty End Unit antenna or transmitter circuitry
- Faulty CDU antenna or receiver circuitry

3.12.3 Front-to-Rear Communications Failure (F TO R FAILURE)

A Front-to-Rear Communications Failure Alarm can be caused by one of the following conditions:

- No confirming message has been received from the End Unit 15 seconds after the EMERGENCY switch was activated.

- No confirming message has been received from the End Unit within approximately 6 minutes and 30 seconds after an Automatic Communication Test from the CDU.

When either of the above conditions occur, the CDU will flash the **F TO R FAILURE** annunciator 5 times accompanied by beeps from the sonalert and will then remain ON.

If a confirming message is received in response to a press of the **COMM ARM** key (manual communications test) or after an Automatic Communication Test, the **F TO R FAILURE** annunciator will turn OFF.

Note, Front-to-Rear Communications problems may be caused by:

- Long tunnels
- Wrong ID Code entered into the CDU
- Discharged battery in the End Unit
- Faulty End Unit antenna or receiver circuitry
- Faulty CDU antenna or transmitter circuitry

3.12.4 ALARM Annunciator

The **ALARM** annunciator operates in conjunction with the **ID Code Display**. When a system alarm condition is initially sensed by the CDU, it will cause the **ALARM** annunciator to flash 5 times together with a message on the **ID Code Display** indicating the nature of the alarm. This is accompanied by beeps from the sonalert. The **ALARM** annunciator will then remain ON and the associated message shown in the **ID Code Display** will alternate every 2 seconds with other existing information (e.g., "ID Code = #####" then "LOW PRES", etc.).

The **ALARM** annunciator and related **ID Code Display** message will turn OFF when the condition is corrected. The types of ALARM conditions are as follows:

1. **Low Pressure Alarm:**

   The Low Pressure Alarm is provided to the locomotive operator as a warning that the brake pipe pressure at the rear of the train has dropped below a specified threshold (typically 45 psig).

   Whenever the brake pressure drops below 45 psig (configurable via the Diagnostic PC), the **ALARM** annunciator will flash ON and the ID Code Display will show **"LOW PRES"**. In addition, the **Brake Pressure Display** will initially flash 5 times showing the current low pressure value.

2. **Valve Fail Alarm:**

   Two-way End Units incorporate a valve fail detection circuit which checks the integrity of the components used to actuate main emergency air exhaust valve. The status of the valve fail detection circuit is transmitted to the CDU in every regularly scheduled message and immediately upon detection of a valve drive circuit failure.

   When a valve failure condition is received by the CDU, the **ALARM** annunciator will flash ON and the ID Code Display will show **"VALVFAIL"**.

3. **No Air Alarm:**

   In order to conserve battery capacity, some End Units automatically power themselves down after the brake pipe pressure drops below 5 psig for more than 5 minutes (PC configurable). Just prior to power down, the End Unit transmits a final message indicating a NO AIR condition.

   When the CDU receives a NO AIR message from the End Unit, the **ALARM** annunciator will flash ON and the **ID Code Display** will show **"NO AIR"**. In addition, the **Brake Pressure Display** will flash 3 dashes **"- - -"** and then stay steady ON. This indicates that the brake pipe pressure at the rear of the train in unknown since the End Unit is now in a powered down state.

4. **Not Armed Alarm:**

   If the Arming process has not yet been performed, the CDU will alert the operator that it is in a Not Armed state, and as such, its Emergency Switch is disabled. The CDU's **ALARM** annunciator will flash ON and the ID Code Display will show **"NOT ARMD"**.

   In addition, for CDUs equipped with the ARMED Status LED on the Front Panel, this LED will be OFF as an additional reminder.

3.13 EMERGENCY BRAKE APPLICATION

To apply the emergency brakes at the rear of the train, lift up the red switch guard and momentarily push the Emergency Switch upwards. The switch is spring loaded and will return to the down position when released. The CDU will immediately transmit an emergency brake command and its **Function Menu Display** will briefly show **"EMERGENCY BRAKE INITIATED"**.

When the End Unit receives the emergency brake command, it will vent the brake pipe air at the rear of the train, transmit a confirming message to the CDU, and drop the pressure to 0 psig. As the air pressure drops, the CDU, in turn, will display a Low Pressure ALARM condition (as described in Section 3.12.4) and the Brake Pressure Display will show 0 psig.

WARNING

If the Arming Security Feature is enabled in the CDU, the Emergency Switch will be inoperative until the Arming sequence as described in Section 3.10 is performed.

CAUTION

The Emergency Switch will activate the Emergency Exhaust Valve of the End Unit whose ID Code is displayed on the CDU and to which the CDU is Armed.

In the event that the End Unit does not correctly respond to the emergency brake command, the CDU automatically transmits retries of the command for a period of 2 minutes. The CDU determines a failure by checking for a brake pipe pressure drop below 5 psig within 4 seconds of the initial emergency request.

During the 2 minute period, the CDU will indicate one of the following:

1. If the CDU is still receiving updates from the End Unit, the **Function Menu Display** continues to flash **"EMERGENCY BRAKE INITIATED"**.

2. If the CDU does not receive any updates from the End Unit within 15 seconds, the **Function Menu Display** will steadily show **"EMERGENCY BRAKE INITIATED"** followed by **a F to R FAILURE ALARM** (per Section 3.12.3).

At the end of the 2 minute period, the **Function Menu Display** will signal a failure by briefly indicating **"EMERGENCY BRAKE FAILED"**.

3.14 COMMUNICATION TEST

If radio communications problems are suspected, the front-to-rear and rear-to-front radio links may be tested by momentarily pressing the **COMM ARM** key.

When the **COMM ARM** key is pressed, the **Function Menu Display** shows:

" WAITING FOR REPLY "

for 2 seconds. Depending on the status of the reply, one of the following will be displayed:

1. If the Communication Test is **successful**, the **Function Menu Display** shows:

" COMM TEST OK "

for 2 seconds and then reverts to the currently active menu item. In addition, the **Message Receipt Indicator** in the Brake Pressure Display will blink ON to indicate that a valid message has been received by the CDU.

2. If the Communication Test **failed**, the **Function Menu Display** shows:

" COMM TEST FAILED "

for 2 seconds and then reverts to the currently active menu item. In this case, the **Message Receipt Indicator** in the Brake Pressure Display will NOT blink ON since no valid message has been received by the CDU.

3.15 AUTOMATIC COMMUNICATION TEST

The CDU automatically checks the radio link on a periodic basis. It sends a status update request message to the End Unit every 10 minutes. The purpose is to test the front-to-rear radio link. If the End Unit replies immediately, no indications are displayed on the CDU front panel. If a reply is not received, the CDU send another request 15 seconds later. If there is no response to this retry, another transmission is made in 6 minutes. If there is no response to this request, a final transmission is made 15 seconds later. Finally, if the End Unit does not reply to this last request, a **F TO R FAILURE** ALARM is declared and displayed on the CDU front panel.

The Automatic Communication Test is performed in the time periods described to allow recovery from radio link “black outs” due to tunnels and certain terrain conditions. The total time to the declaration of a **F TO R FAILURE** ALARM is 16.5 minutes.

3.16 CDU DATALOGGER PORT

The CDU supports two Data Logger Port protocol output formats. These are configurable via the Diagnostic PC by selecting either “Data Logger Protocol” or “Event Recorder Protocol” (see Section IV).

3.16.1 Data Logger Format

This section describes the data format output by the CDU in the case where it has been configured for “Data Logger Protocol” from the Diagnostic PC.

The CDU transmits a data message to the data logger serial port whenever an “event” occurs. An event is defined as a change in certain indicators on the front panel display or when a radio transmission is received from the End Unit.

Each event produces an 11 character output from the port as defined below. Time stamping of the message, if required, is provided by the event recorder device receiving and logging the data.

Character Position	Description
1	Start Character (Line Feed)
2	ASCII Character
3	ASCII Character
4	ASCII Character
5	ASCII Character
6	ASCII Character
7	ASCII Character
8	ASCII Character
9	ASCII Character
10	Unit Transmission Indicator
11	End Character (Carriage Return)

The 8 character ASCII field can be assigned to any message that is deemed worthy of recording, however there are a number of characters that have specific definitions in normal operation.

During normal operation, the character in position 2 is used to indicate the state of the telemetry battery.

W = Weak
R = Replace

The character in position 3 is used to indicate the following.

* = Marker Light Turn ON, first occurrence only.
R = Replace Marker Battery.

The character in position 4 is used to indicate the following:

< = Reply from End Unit is pending.
+ = Reply from End Unit is pending.
! = Emergency Brake Application has been transmitted.
I = The End Unit is operating in One-way mode.
U = The CDU is in two-way mode but has not been armed.

The character in position 5 is used to indicate status of the End Unit brake valve drive circuitry as follows:

V = Brake Valve Drive Circuit Failure.

The character in position 6 is used to indicate motion and direction.

> = Indicates Forward direction
< = Indicates Reverse direction
^ = Indicates Moving (after forward or reverse have occurred)
- = Indicates Stopped

The characters in positions 7, 8, and 9 are used indicate the current brake pressure value. The range is from " 0" psig (leading zeros are space characters) to "125" psig.

The Unit Transmission Indicator in position 10 is used to indicate whether the datalogger port output message was the result of a change in CDU display status or as a result of a status update message received from the End Unit.

" " = The event was the result of a change in CDU display status
= The event was the result of a status update message received from the End Unit.

A typical data logger message would be:

" R * 74# "

meaning that:

1. the Telemetry battery is low and will need to be replaced soon,

2. the Marker Light has just come on,

3. the brakepipe pressure is 74 psig,

4. the event was initiated as the result of a spontaneous status update message from the End Unit or a status update message due to a communications test (manual or automatic).

Defined ASCII Messages:

In addition to the above characters, specific ASCII messages are transmitted by the Data Logger Port as follows:

1. If the CDU has a valid ID number but has not been armed to this ID, the message

“ NOT ARMD “

is output to the Datalogger Port. Until such time as the CDU is armed to the End Unit with this ID, all subsequent outputs will carry the “U” in character position 4.

2. If the CDU has declared a Rear-to-Front Communications Failure, the following message is output to the Datalogger Port:

“ R>F FAIL “

3. If the CDU has declared a Front-to-Rear Communications Failure, the following message is output to the Datalogger Port:

“ F>R FAIL “

4. If the End Unit powers down as a result of the brakepipe pressure dropping to < 5 psig, the following message is output to the Datalogger Port:

“ NO AIR # “

5. If the CDU is in the ID Scan Mode where it is displaying all incoming IDs, all readable IDs are output to the data logger port in the following format:

“ ID=12345 “

6. If an ARM NOW message is received from the End Unit, the following message is output to the Datalogger Port:

“ ARM NOW# “

7. If the Arming process has failed, the following message is output to the Datalogger Port:

“ ARM FAIL “

8. If the Arming process was successful, the following message is output to the Datalogger Port:

“ ARMED “

9. On CDU power-up, the following messages are output to the Datalogger Port:

“ US&S6696“ followed by **“POWERUP”**

10. If a failure occurs during the CDU power-up self-test sequence, the following messages are output to the Datalogger Port:

“ SELFTEST“ followed by **“FAIL ”**

3.16.2 Event Recorder Format

CDUs configured for “Event Recorder Protocol” conform to the data transfer protocol described in this section.

3.16.2.1 Electrical Characteristics

Data is transmitted as follows:

1) RS-232/C Signal Levels

2) Asynchronous, serial

3) Baud Rate, Start Bit, Data Bits, Stop Bit, and Parity as configured via the Diagnostic PC. Standard event recorders typically require these to be set to 1200 Baud, 1 Start Bit, 8 Data Bits, 1 Stop Bit, and No Parity.

4) Messages are sent every 0.5 seconds, or immediately upon change of any data.

3.16.2.2 Data Transfer Protocol

Messages are transmitted per the following format:

		Bit Position		
Message Byte		7654	3210	Comment
Byte 1	Sync Byte	1010	1010	"AA" Hex
Byte 2	Sync Byte	1010	1010	"AA" Hex
Byte 3	Events 1	0abc	defg	Note 1
Byte 4	Events 2	0tuv	wxyz	Note 2
Byte 5	Pressure	0ppp	pppp	Note 3
Byte 6	CRC - HIGH			Note 4
Byte 7	CRC - LOW			Note 4

Refer to the following pages for a description of each individual bit assignment.

Note 1:

Bit	State	Description
7	N/A	Always set to 0.
a		EOT Dump Valve Status (ie., End Unit confirmation bit status)
	0	Inactive - Confirmation bit not set.
	1	Active - Confirmation bit set.
b		EOT Type
	0	One-Way Rear EOT Unit.
	1	Two-Way Rear EOT Unit.
c		HVM Light Status
	0	HVM Light OFF (ie., not flashing).
	1	HVM Light ON (ie., flashing).
d		EOT Telemetry Battery Status
	0	Battery OK.
	1	Battery status is WEAK or REPLACE.
e		EOT Message Status
	0	Regular 0.5 second message.
	1	New message just received from EOT.
f		EOT Moving Status
	0	EOT is stopped.
	1	EOT is moving (including forward and reverse).
g		Rear-to-Front Radio Communications
	0	R -> F communication is OK.
	1	R -> F communication is not OK.

Note 2:

Bit	State	Description
7	N/A	Always set to 0.
t	N/A	Always set to 1.
u	N/A	Always set to 1.
v	N/A	Always set to 1.
w	N/A	Always set to 1.
x	N/A	Always set to 1.
y		HOT Emergency (CDU Emergency Switch Status)
	0	CDU Emergency Switch open (released).
	1	CDU Emergency Switch closed (active).
z		HOT Type (One or Two Way Front Unit, Always 1 for CDU)
	0	One-Way type Front EOT Unit.
	1	Two-Way type Front EOT Unit.

Note 3:

EOT Pressure information. Pressure range is 0 to 127 PSI (1 PSI resolution). Bit 7 is always set to 0, bit 0 is the least significant bit (LSB).

Note 4:

The CRC is a 16 bit code computed ONLY from Data Bytes 3, 4, and 5; the two Sync Bytes ("AA" bytes) are excluded from the CRC calculation.

The CRC is computed according the specifications of CRC-CCITT, as implemented in X-MODEM-CRC using the CCITT polynomial of 0x1021.

The high byte of the CRC is transmitted first.

4.0 CONFIGURATION and DIAGNOSTICS

A dedicated serial port, labeled DIAG, is located on the CDU's Rear Panel Assembly. The port uses a standard 9-pin plug type RS-232/C "D" connector and interfaces to an IBM compatible PC via a "straight-through" off-the-shelf 9-pin serial cable. All CDU configuration and diagnostics are performed using the DIAG port in conjunction with Diagnostic Software running on a PC.

4.1 Diagnostic Software

The Diagnostic Software is a single program named **diagunit.exe** supplied on a floppy disk. The software can be ordered under US&S part number N4512321264 (3.5" disk) or N4512321265 (5.25" disk). The software incorporates a full set of diagnostic functions for maintenance purposes and supports the capability to fully configure the CDU's operating functions.

This manual provides examples of the diagnostic functions and provides detailed information on CDU configuration. Refer to Service Manual SM 7064 (Shop Maintenance) for detailed diagnostic information and procedures.

4.1.1 Running the Diagnostic Software

To run the Diagnostic Software, perform the following:

1. Power-up the CDU. Do NOT plug the serial cable into the DIAG connector yet. Let the CDU execute its normal power-up sequence. Also power-up the diagnostic PC, if it's not already on.

2. Now connect the "straight-through" (not null modem) serial communications cable between the diagnostic PC and the CDU's rear mounted DIAG connector.

NOTE

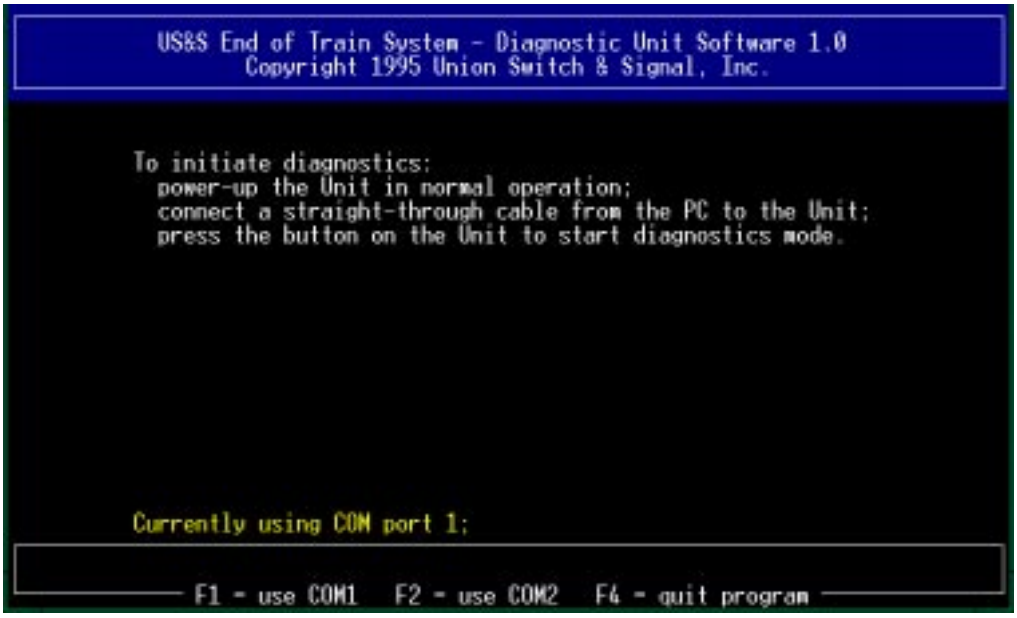
The CDU's DIAG port is permanently set up for 9600 baud, 8 data bits, 1 stop bit, and no parity.

3. On the PC, execute the Diagnostic Software from the floppy disk, or from the hard disk if it has been copied there, by typing **"diagunit"** followed by **<Enter>**.

4. The Communications Set-Up Screen will appear as shown on the next page. The program name and version appear at the top of the screen. The box at the bottom of the screen displays any prompts for user input. The last line shows applicable PC function keys.

5. The Diagnostic Software defaults to PC serial port COM1. If use of COM2 is required, press <F2> to use COM2. Press <F1> to return to COM1.

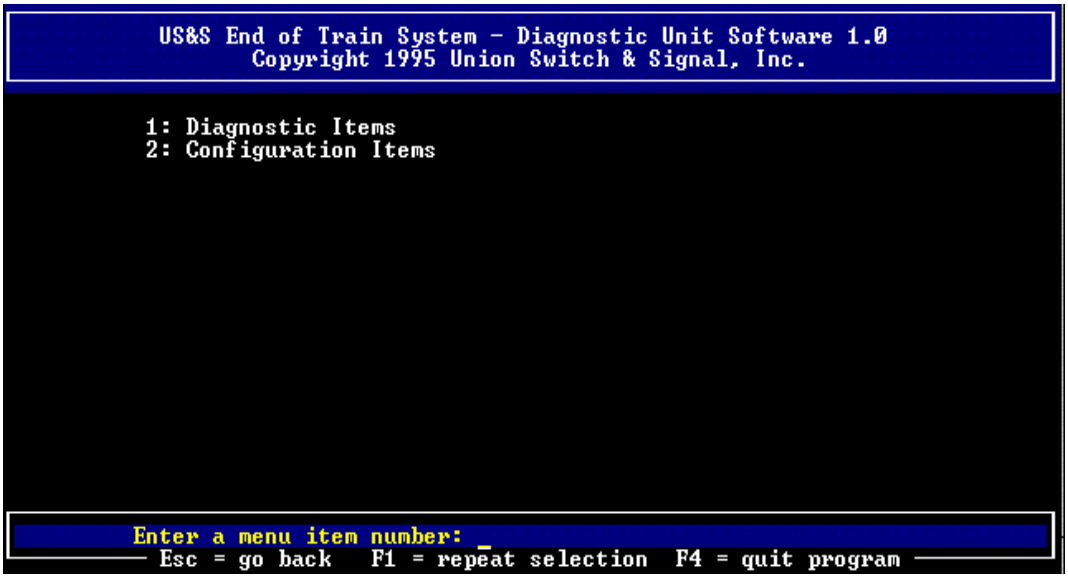
6. To quit the program at any time, press <F4>. The program will prompt with **"Really quit? [Y, N]:".** If "Y" is selected, the program will terminate. If "N" is selected, the program continues.


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
To initiate diagnostics:
power-up the Unit in normal operation;
connect a straight-through cable from the PC to the Unit;
press the button on the Unit to start diagnostics mode.
Currently using COM port 1;
F1 - use COM1 F2 - use COM2 F4 - quit program

7. To initiate the diagnostic Main Menu, press any of the CDU's Function Control Keys.

4.2 Main Menu

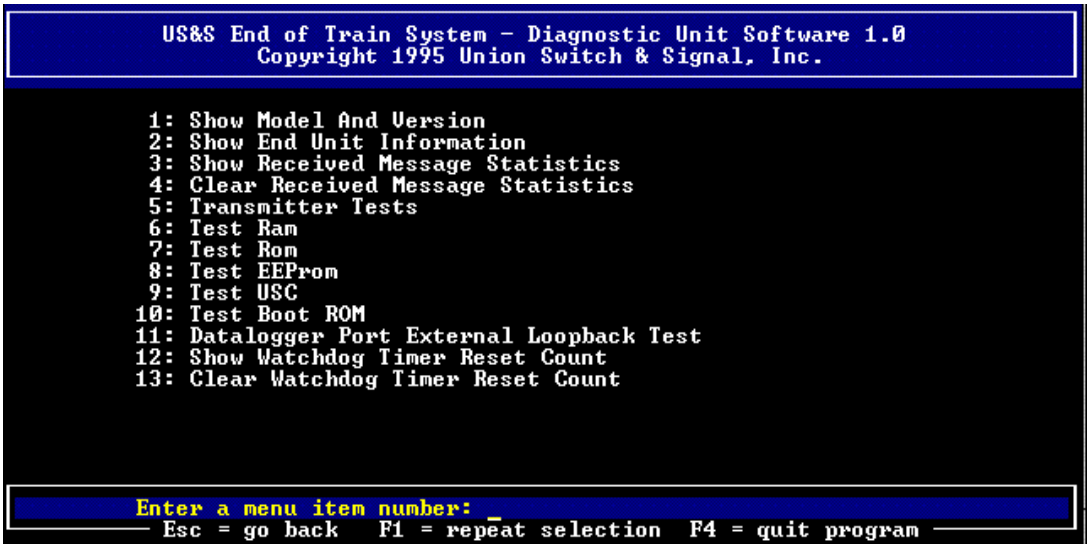
When the CDU is operating in diagnostic mode, the first screen displayed on the PC is the Main Menu.


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
1: Diagnostic Items
2: Configuration Items
Enter a menu item number:
Esc = go back F1 = repeat selection F4 = quit program

To select one of the submenus associated with **Diagnostic Items** or **Configuration Items**, type the desired menu item number and press <Enter>.

4.3 Diagnostic Items

This Diagnostic Items Menu displays selections which may show information about, or perform a diagnostic test on specific elements of the CDU.

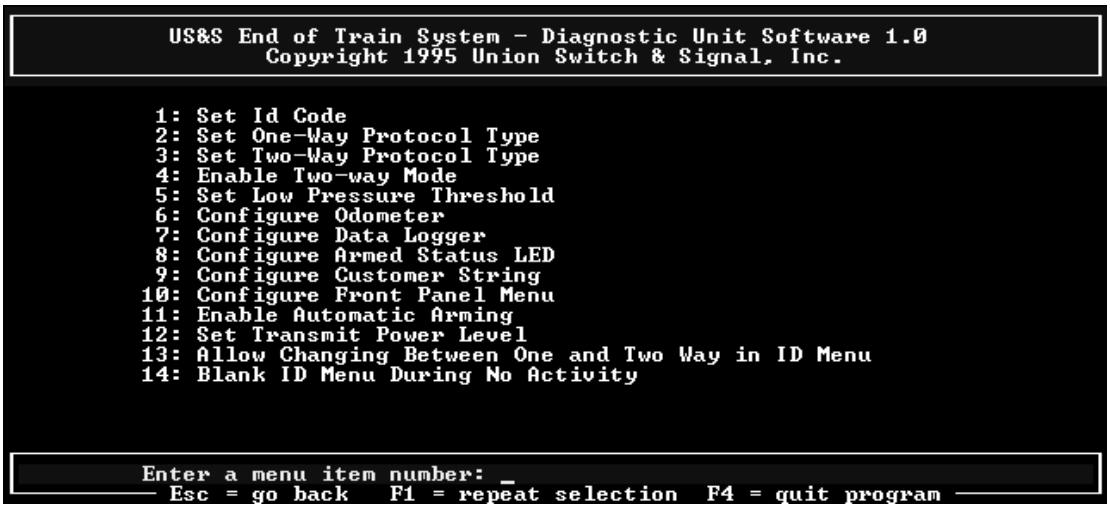

US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
1: Show Model And Version
2: Show End Unit Information
3: Show Received Message Statistics
4: Clear Received Message Statistics
5: Transmitter Tests
6: Test Ram
7: Test Rom
8: Test EEProm
9: Test USC
10: Test Boot ROM
11: Datalogger Port External Loopback Test
12: Show Watchdog Timer Reset Count
13: Clear Watchdog Timer Reset Count
Enter a menu item number:
Esc = go back F1 = repeat selection F4 = quit program

Select a diagnostic test from this menu by typing in a menu item number followed by <Enter>. To return to the Main Menu, press <Esc>.

The use of the Diagnostic Items is beyond the scope of this manual. These are each described in detail in the CDU Shop Maintenance Manual, SM 7064.

4.4 Configuration Items Menu

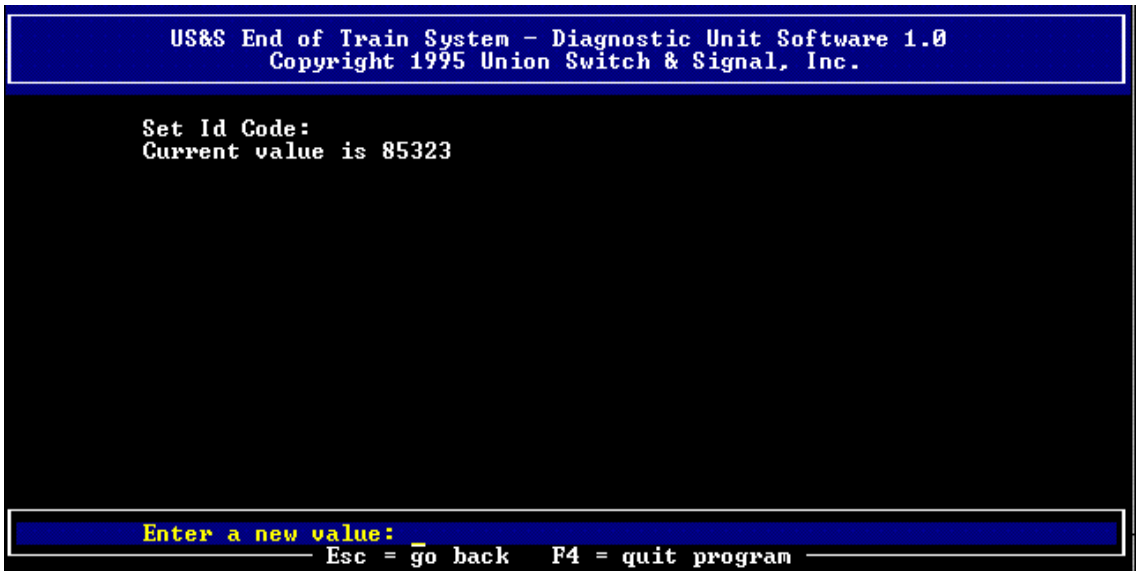
The Configuration Items Menu displays selections which allow CDU functions to be enabled or disabled and also allows customization of certain functions. This section describes the purpose and use of each menu item as shown below in the Main Configuration Menu:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
1: Set Id Code
2: Set One-Way Protocol Type
3: Set Two-Way Protocol Type
4: Enable Two-way Mode
5: Set Low Pressure Threshold
6: Configure Odometer
7: Configure Data Logger
8: Configure Armed Status LED
9: Configure Customer String
10: Configure Front Panel Menu
11: Enable Automatic Arming
12: Set Transmit Power Level
13: Allow Changing Between One and Two Way in ID Menu
14: Blank ID Menu During No Activity
Enter a menu item number:
Esc = go back F1 = repeat selection F4 = quit program

To select an item from this menu, type in a menu item number and press <Enter>. To return to the Main Menu, press <Esc>.

4.4.1 Set ID Code

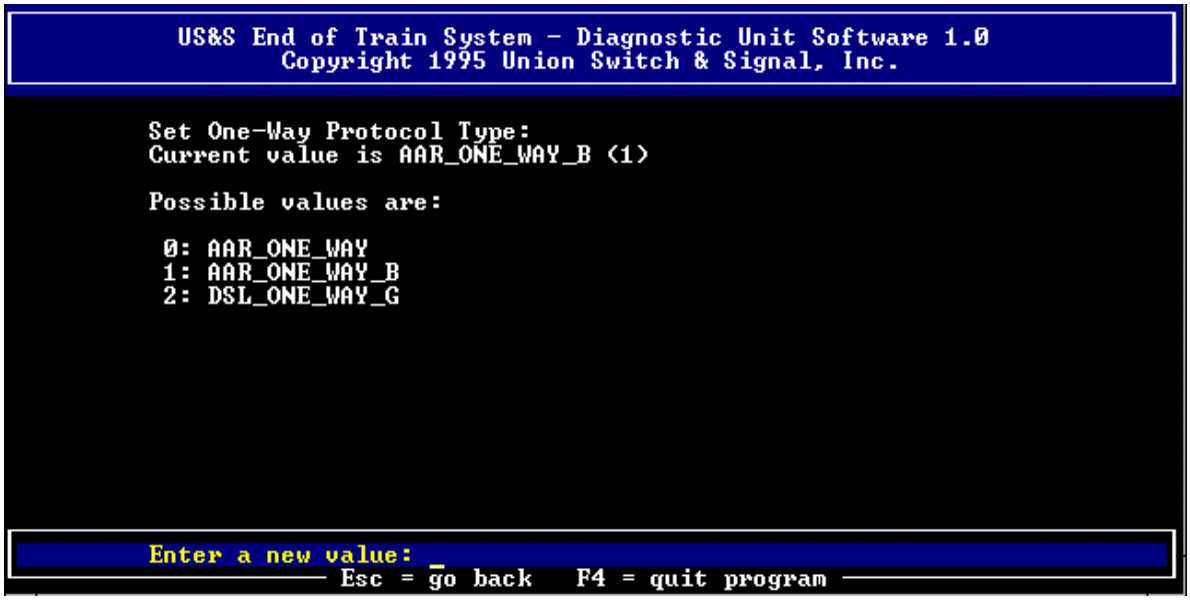
To read the currently stored ID code or modify the ID code without using the CDU Function Control Keys, select item “1” (Set Id Code) from the Main Configuration Menu and press <Enter>. The following screen showing the current ID will appear:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Id Code:
Current value is 85323
Enter a new value:
Esc = go back F4 = quit program

To modify the ID code, type in a new 5 digit ID code and press <Enter>. The new ID code will be updated on the PC screen and will also be displayed on the CDU’s ID Code Display. This menu item may be particularly useful when servicing a CDU with faulty Function Control Keys. To return to the Main Configuration Menu, press <Esc>.

4.4.2 Set One-Way Protocol Type

To read the current One-Way protocol setting or modify the protocol, select item “2” (Set One-Way Protocol Type) from the Main Configuration Menu and press <Enter>. The following screen showing the current protocol will appear:

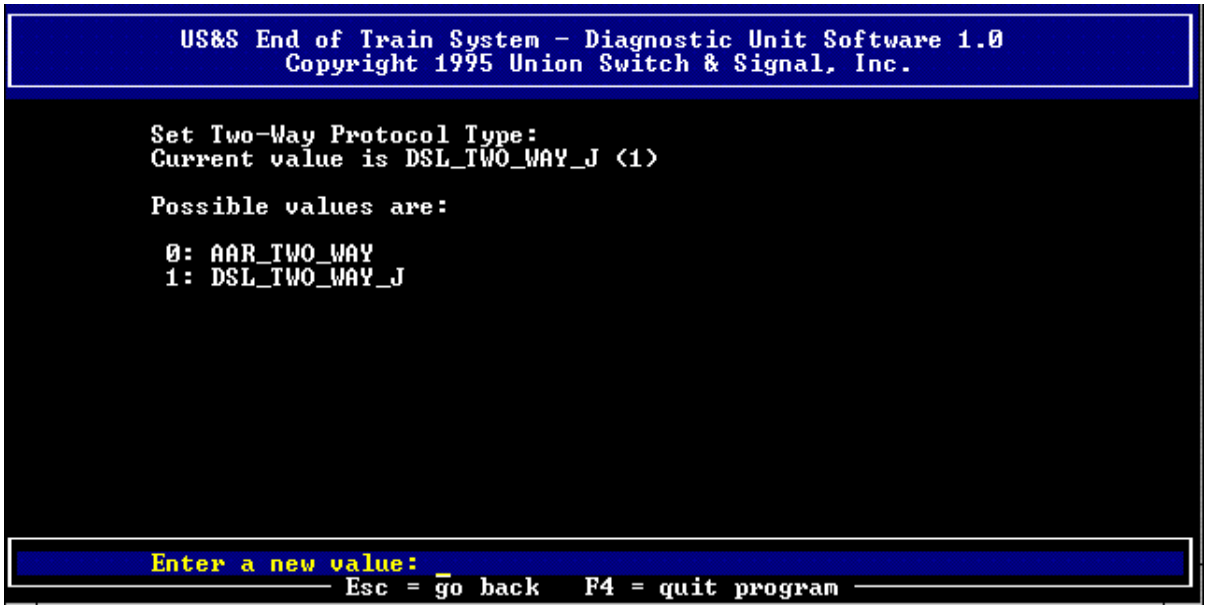

US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set One-Way Protocol Type:
Current value is AAR_ONE_WAY_B (1)
Possible values are:
0: AAR_ONE_WAY
1: AAR_ONE_WAY_B
2: DSL_ONE_WAY_G
Enter a new value:
Esc = go back F4 = quit program

To modify the protocol, type in the number of the desired protocol and press <Enter>. The selected protocol will be the one used by the CDU when the user wishes to switch to One-Way operation as prompted by the “Press SET to change to One-Way” function during the entry of a new ID code.

To return to the Main Configuration Menu, press <Esc>.

4.4.3 Set Two-Way Protocol Type

To read the current Two-Way protocol setting or modify the protocol, select item “3” (Set Two-Way Protocol Type) from the Main Configuration Menu and press <Enter>. The following screen showing the current protocol will appear:

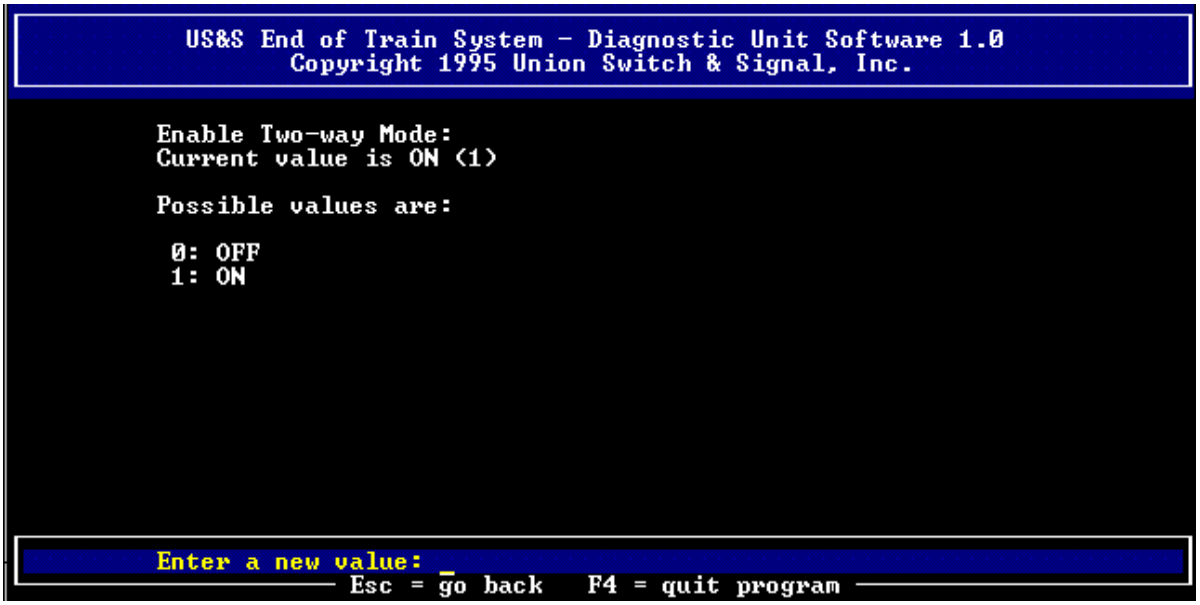

US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Two-Way Protocol Type:
Current value is DSL_TWO_WAY_J (1)
Possible values are:
0: AAR_TWO_WAY
1: DSL_TWO_WAY_J
Enter a new value:
Esc = go back F4 = quit program

To modify the protocol, type in the number of the desired protocol and press <Enter>. The selected protocol will be the one used by the CDU when the user wishes to switch to Two-Way operation as prompted by the “Press SET to change to Two-Way” function during the entry of a new ID code.

To return to the Main Configuration Menu, press <Esc>.

4.4.4 Enable Two-Way Mode

To read the current Mode setting or enable/disable the two-way mode, select item “4” (Enable Two-Way Mode) from the Main Configuration Menu and press <Enter>. The following screen showing the current mode will appear:

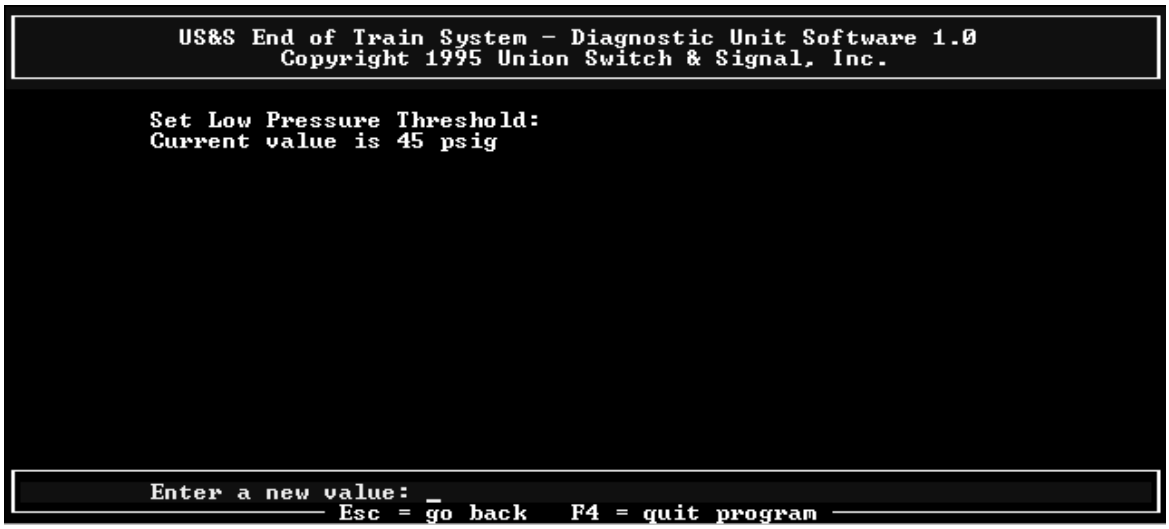

US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Enable Two-way Mode:
Current value is ON (1)
Possible values are:
0: OFF
1: ON
Enter a new value:
Esc = go back F4 = quit program

To default the initial power-up mode to One-Way or Two-Way Mode, type in the number of the desired mode and press <Enter>. The selected mode will be the one used by the CDU when it is powered ON. Subsequent changes via the CDU front panel using the “Press SET to change to One-Way” or the “Press SET to change to Two-Way” functions during the entry of a new ID code will change the operating mode accordingly in the normal fashion.

To return to the Main Configuration Menu, press <Esc>.

4.4.5 Set Low Pressure Threshold

To read the current Low Pressure Threshold value or change the value, select item “5” (Set Low Pressure Threshold) from the Main Configuration Menu and press <Enter>. The following screen showing the current value will appear:

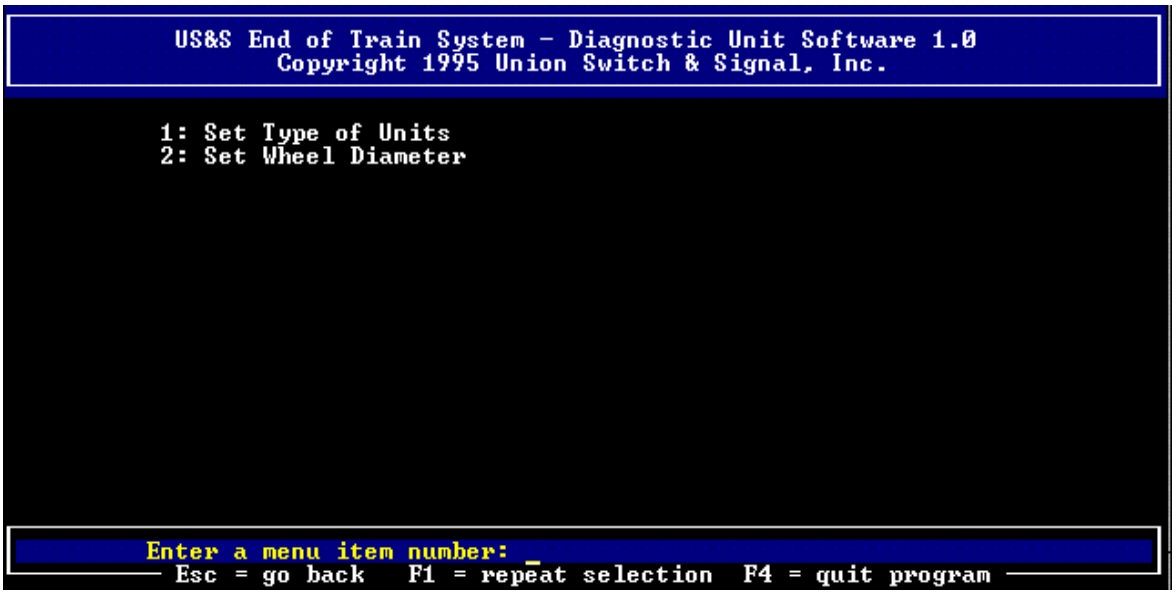

US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Low Pressure Threshold:
Current value is 45 psig
Enter a new value: _
Esc = go back F4 = quit program

The factory default setting is 45 psig. When the brake pipe pressure drops below this value, the CDU will indicate a Low Pressure ALARM as a warning to the locomotive operator. To change the low pressure setting, type in the new threshold value and press <Enter>.

To return to the Main Configuration Menu, press <Esc>.

4.4.6 Configure Odometer

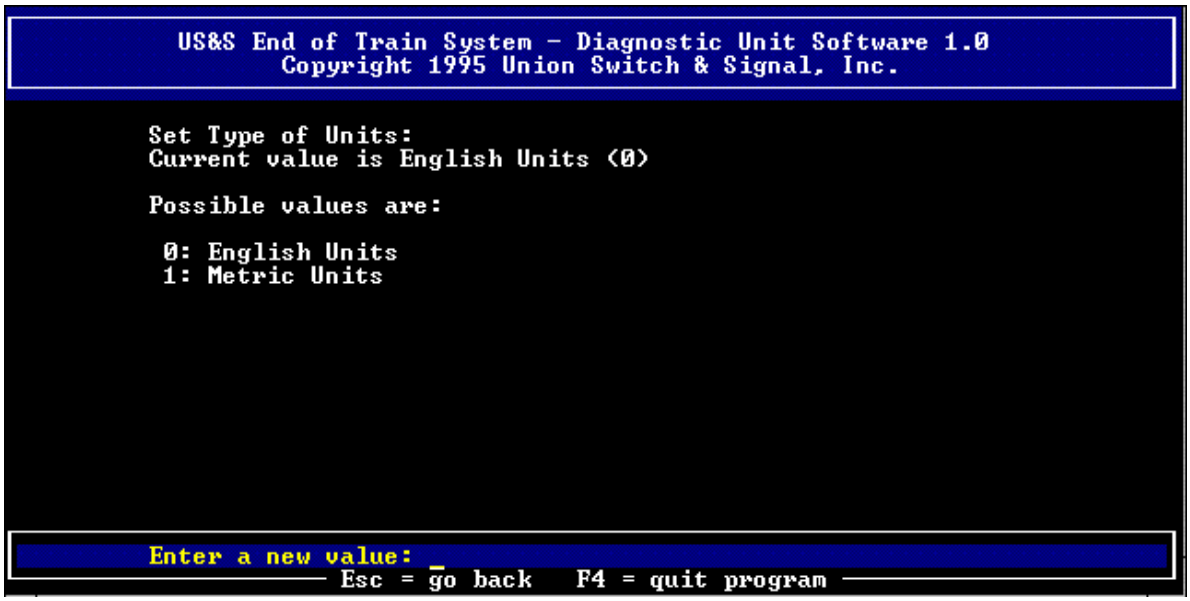
To configure the odometer related functions for the type of units displayed (English or Metric) or to set the locomotive wheel diameter, select item “6” (Configure Odometer) and press <Enter>. The following screen showing the associated submenus will appear:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
1: Set Type of Units
2: Set Wheel Diameter
Enter a menu item number:
Esc = go back F1 = repeat selection F4 = quit program

To select an item from this submenu, type in a menu item number and press <Enter>. To return to the Main Menu, press <Esc>.

4.4.6.1 Set Type of Units Submenu

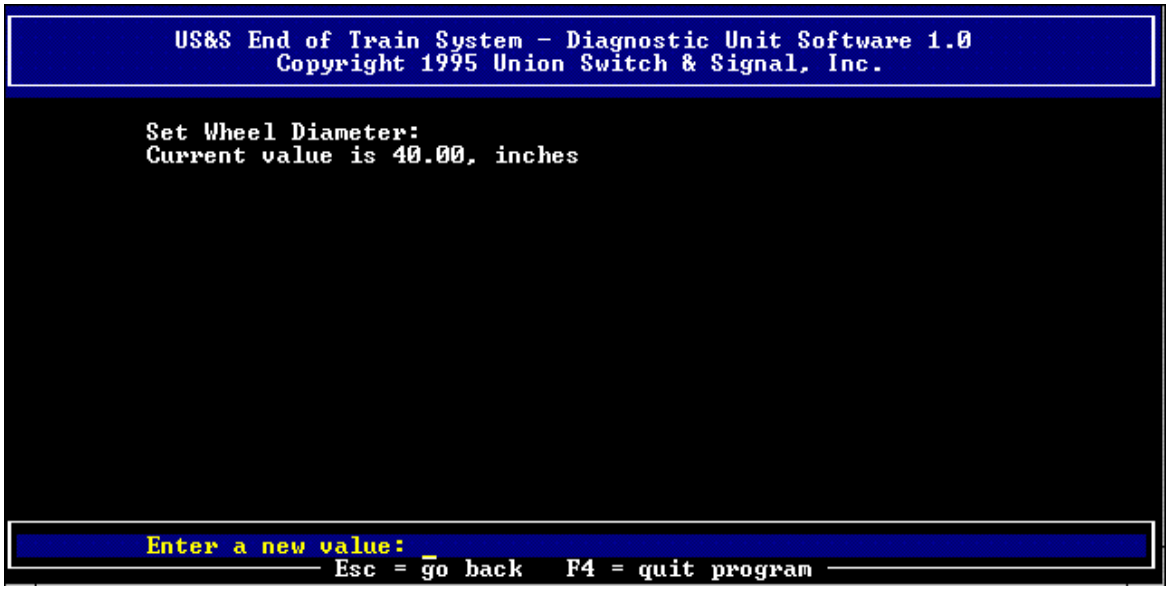
The screen below shows the current Unit selection:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Type of Units:
Current value is English Units (0)
Possible values are:
0: English Units
1: Metric Units
Enter a new value:
Esc = go back F4 = quit program

The factory default is English units. To select English or Metric Units to be used for display when using the odometer related functions, type in a menu item number and press <Enter>. To return to the Configure Odometer Menu, press <Esc>.

4.4.6.2 Set Wheel Diameter Submenu

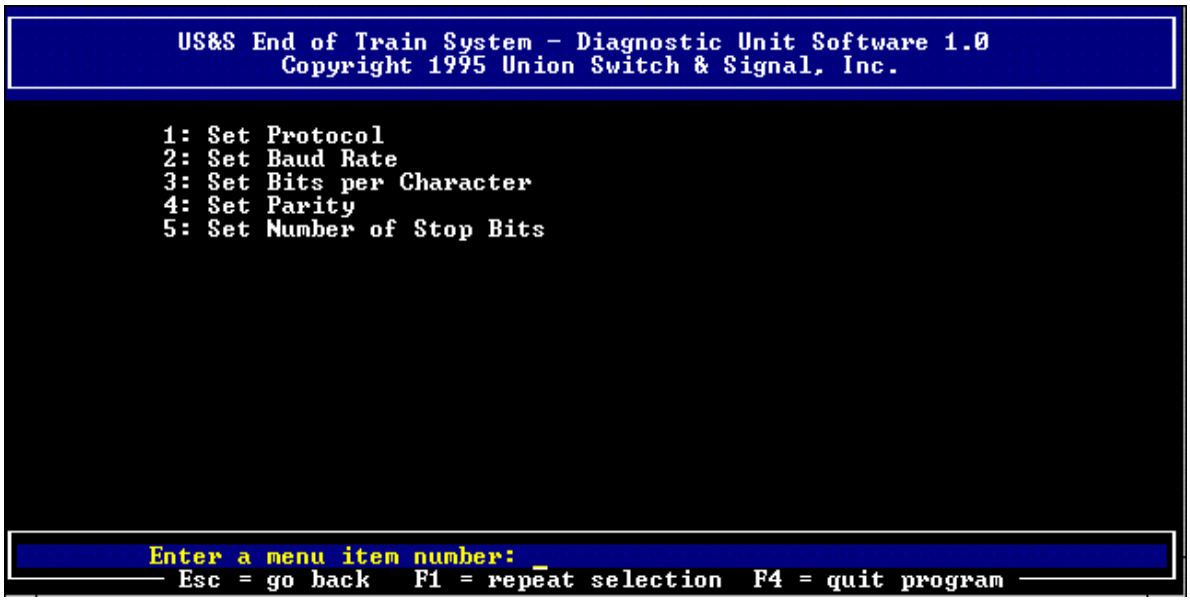
The screen below shows the current value of the locomotive wheel diameter:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Wheel Diameter:
Current value is 40.00, inches
Enter a new value:
Esc = go back F4 = quit program

The factory default for the locomotive wheel diameter is 40.00 inches. To change the wheel diameter value, type in the numeric value of the wheel diameter in the range of 34.00 inches to 46.00 inches and press <Enter>. To return to the Configure Odometer Menu, press <Esc>.

4.4.7 Configure Data Logger

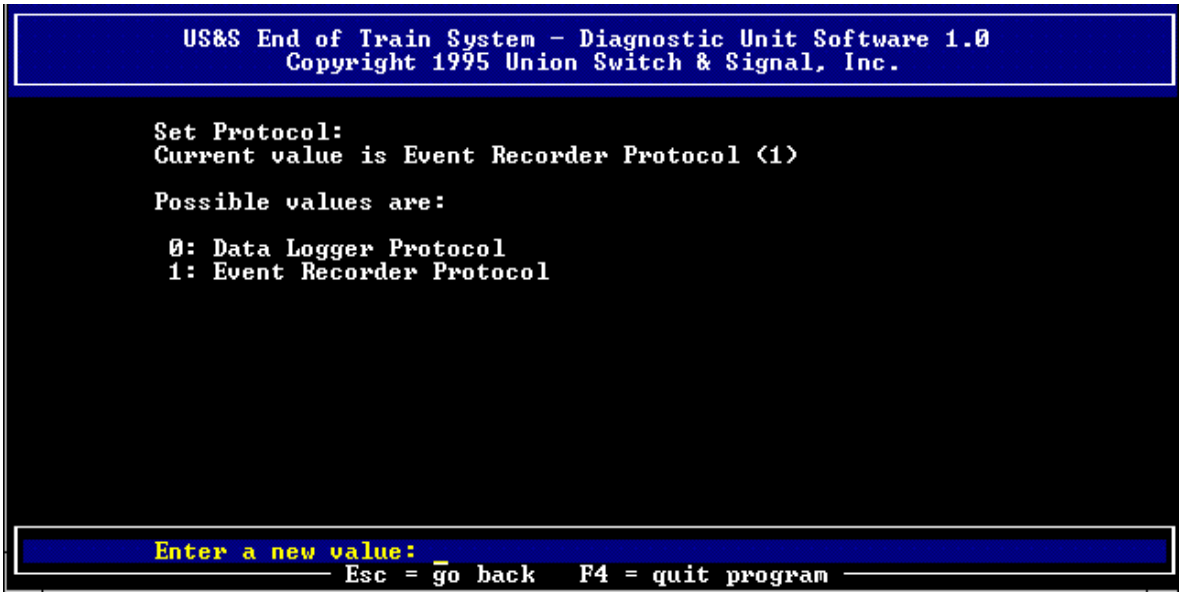
To configure the Data Logger protocol and its associated transmission parameters, select item “7” (Configure Data Logger) and press <Enter>. The following screen showing the associated submenus will appear:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
1: Set Protocol
2: Set Baud Rate
3: Set Bits per Character
4: Set Parity
5: Set Number of Stop Bits
Enter a menu item number:
Esc = go back F1 = repeat selection F4 = quit program

To select an item from this submenu, type in a menu item number and press <Enter>. To return to the Main Menu, press <Esc>.

4.4.7.1 Set Protocol

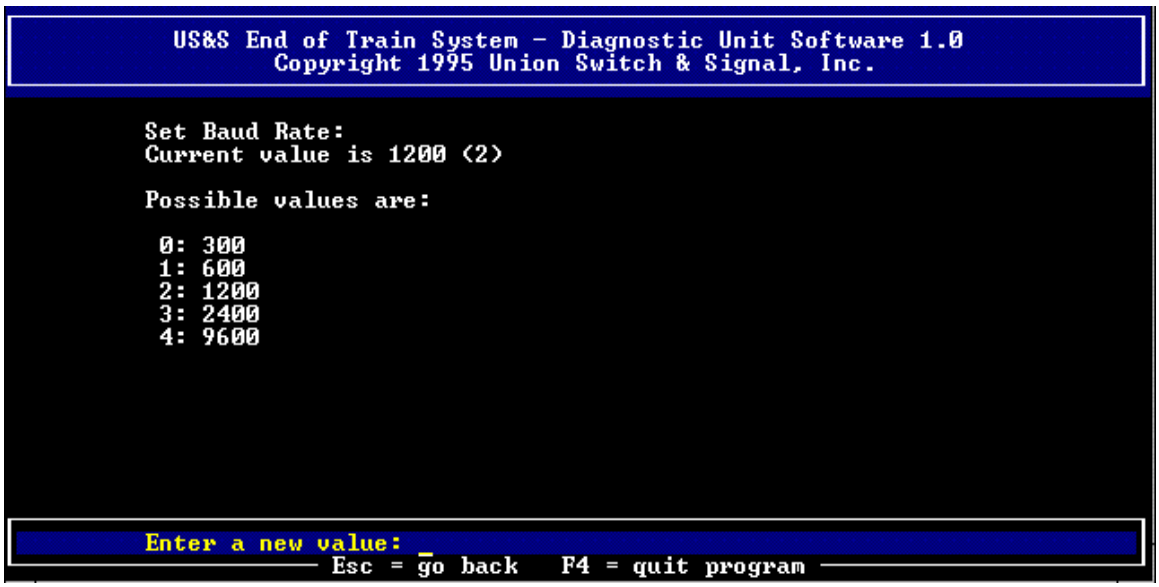
The screen below shows the current data logger protocol selection.


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Protocol:
Current value is Event Recorder Protocol (1)
Possible values are:
0: Data Logger Protocol
1: Event Recorder Protocol
Enter a new value:
Esc = go back F4 = quit program

The factory default protocol is “Data Logger Protocol” as defined in Section 3.16.1. The “Event Recorder Protocol” is described in Section 3.16.2. To change the protocol, type in the desired submenu item number and press <Enter>. To return to the Set Protocol menu, press <Esc>.

4.4.7.2 Set Baud Rate

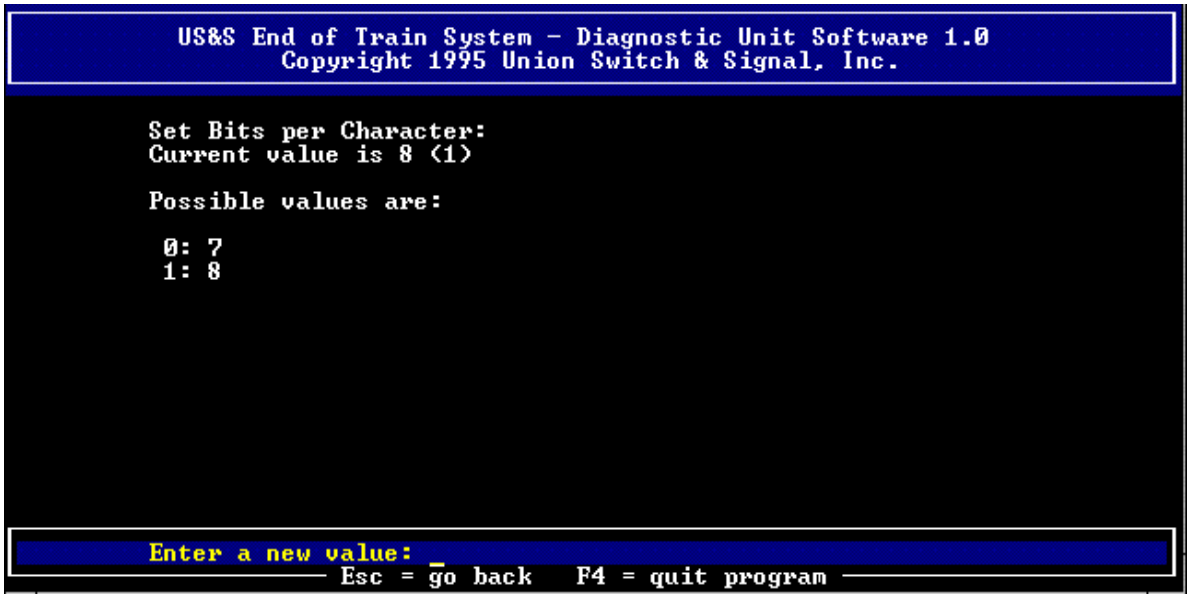
The screen below shows the current baud rate setting.


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Baud Rate:
Current value is 1200 (2)
Possible values are:
0: 300
1: 600
2: 1200
3: 2400
4: 9600
Enter a new value:
Esc = go back F4 = quit program

To change the baud rate setting, type in the desired submenu item number and press <Enter>. To return to the Set Protocol menu, press <Esc>.

4.4.7.3 Set Bits per Character

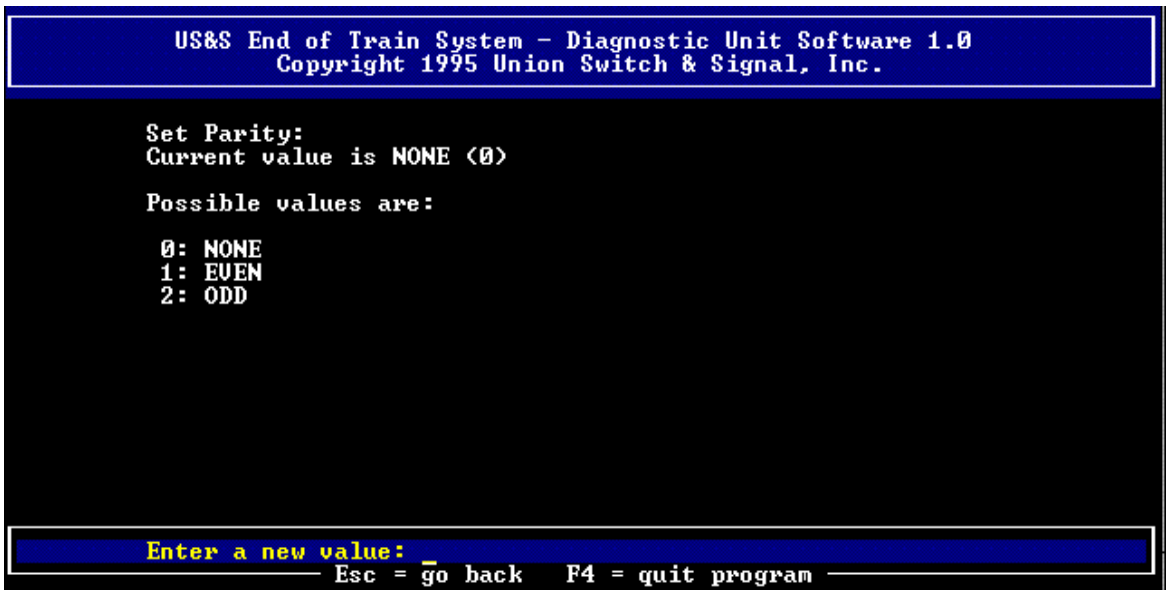
The screen below shows the current bits per character setting.


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Bits per Character:
Current value is 8 (1)
Possible values are:
0: 7
1: 8
Enter a new value:
Esc = go back F4 = quit program

To change the number of bits per character, type in the desired submenu item number and press <Enter>. To return to the Set Protocol menu, press <Esc>.

4.4.7.4 Set Parity

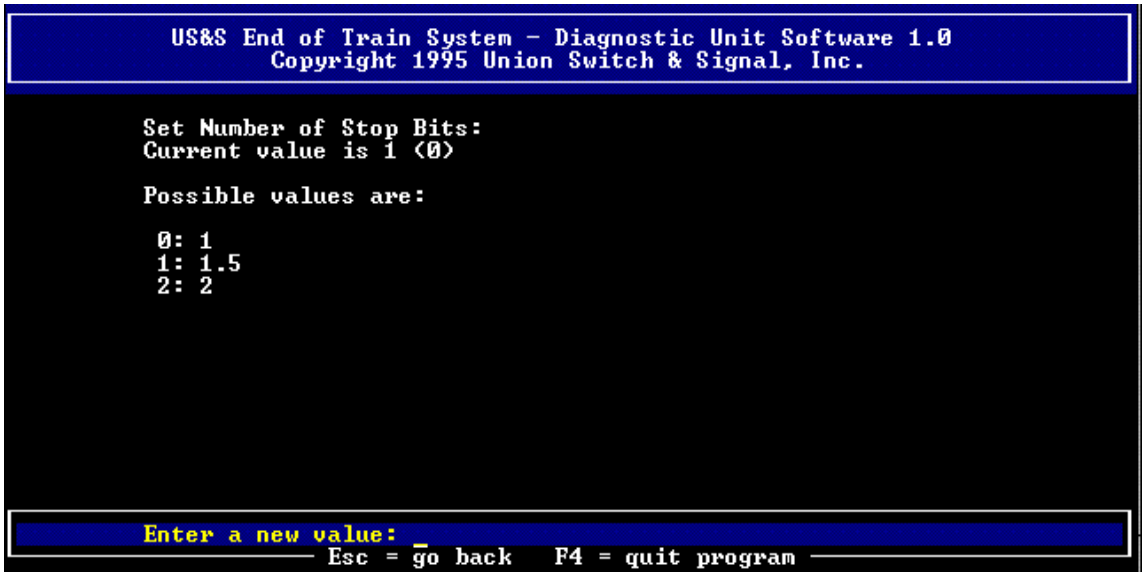
The screen below shows the current parity setting.


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Parity:
Current value is NONE (0)
Possible values are:
0: NONE
1: EVEN
2: ODD
Enter a new value:
Esc = go back F4 = quit program

To change the parity, type in the desired submenu item number and press <Enter>. To return to the Set Protocol menu, press <Esc>.

4.4.7.5 Set Number of Stop Bits

The screen below shows the current setting of the number of stop bits.


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Number of Stop Bits:
Current value is 1 (0)
Possible values are:
0: 1
1: 1.5
2: 2
Enter a new value:
Esc = go back F4 = quit program

To change the stop bits setting, type in the desired submenu item number and press <Enter>. To return to the Set Protocol menu, press <Esc>.

4.4.8 Configure Armed Status LED

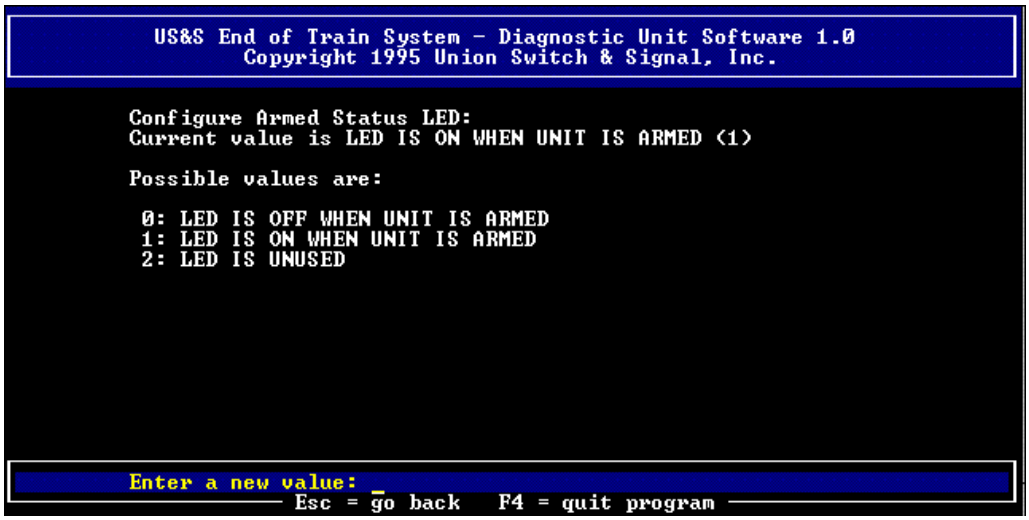
Three versions of the CDU Front Panel are available to accommodate the Armed Status LED as follows:

1. Panel marked with **NOT ARMED**. LED turns ON when CDU is disarmed.

2. Panel marked with **ARMED**. LED turns ON when the CDU is armed.

3. Panel with NO marking. LED is not used.

To configure the operation of the Armed Status LED, select item “8” (Configure Armed Status LED) and press <Enter>. The following screen showing the menu items will appear:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Configure Armed Status LED:
Current value is LED IS ON WHEN UNIT IS ARMED (1)
Possible values are:
0: LED IS OFF WHEN UNIT IS ARMED
1: LED IS ON WHEN UNIT IS ARMED
2: LED IS UNUSED
Enter a new value:
Esc = go back F4 = quit program

The default configuration setting is menu item 1: LED IS ON WHEN ARMED for use with a Front Panel marked with ARMED.

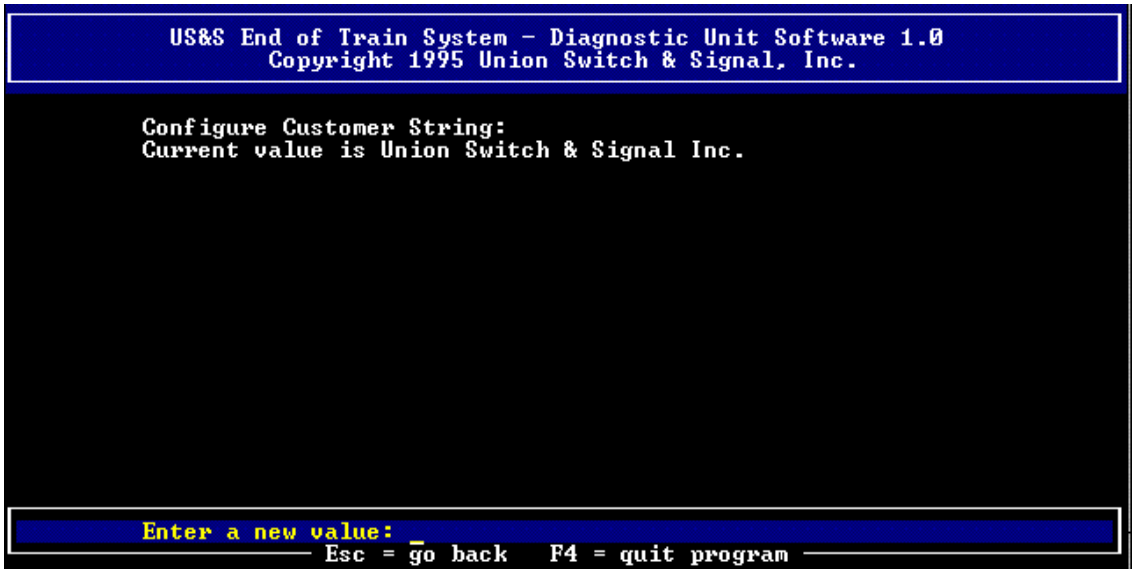
Select menu item 0: LED IS OFF WHEN UNIT ARMED for use with a Front Panel marked with NOT ARMED.

Select menu item 2: LED IS UNUSED for use with unmarked Front Panels.

Press <Esc> to return to the Main Configuration Menu.

4.4.9 Configure Customer String

During the power-up sequence, the CDU displays the currently stored Customer String. To view or modify the customer string, select item “9” (Configure Customer String) and press <Enter>. The following screen showing the customer string will appear:

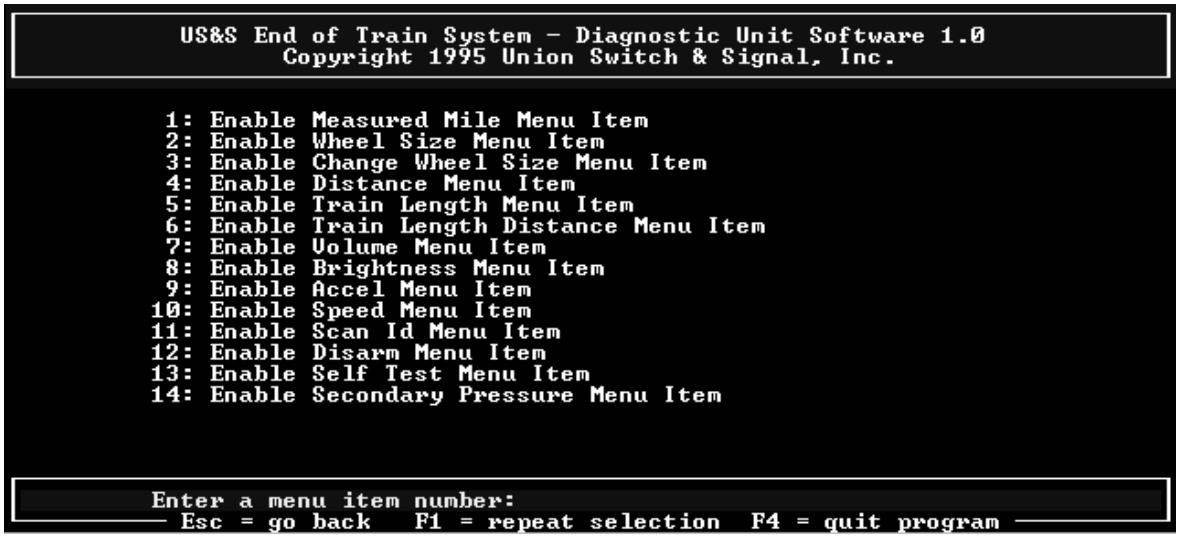

US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Configure Customer String:
Current value is Union Switch & Signal Inc.
Enter a new value:
Esc = go back
F4 = quit program

To modify the Customer String, type in the desired alphanumeric string (e.g., “XYZ Railway Inc.”) and press <Enter>. To return to the Main Configuration Menu, press <Esc>.

4.4.10 Configure Front Panel Menu

As listed in Table 3.1, each CDU menu function can be enabled or disabled depending on specific Railway requirements. When a Function Menu Item is disabled, it will NOT appear in the Function Menu Display when the MENU UP or MENU DOWN key is pressed.

To view the Front Panel Menu items, select item “10” (Configure Front Panel Menu) and press <Enter>. The following screen listing the menu items will appear:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
1: Enable Measured Mile Menu Item
2: Enable Wheel Size Menu Item
3: Enable Change Wheel Size Menu Item
4: Enable Distance Menu Item
5: Enable Train Length Menu Item
6: Enable Train Length Distance Menu Item
7: Enable Volume Menu Item
8: Enable Brightness Menu Item
9: Enable Accel Menu Item
10: Enable Speed Menu Item
11: Enable Scan Id Menu Item
12: Enable Disarm Menu Item
13: Enable Self Test Menu Item
14: Enable Secondary Pressure Menu Item
Enter a menu item number:
Esc = go back F1 = repeat selection F4 = quit program

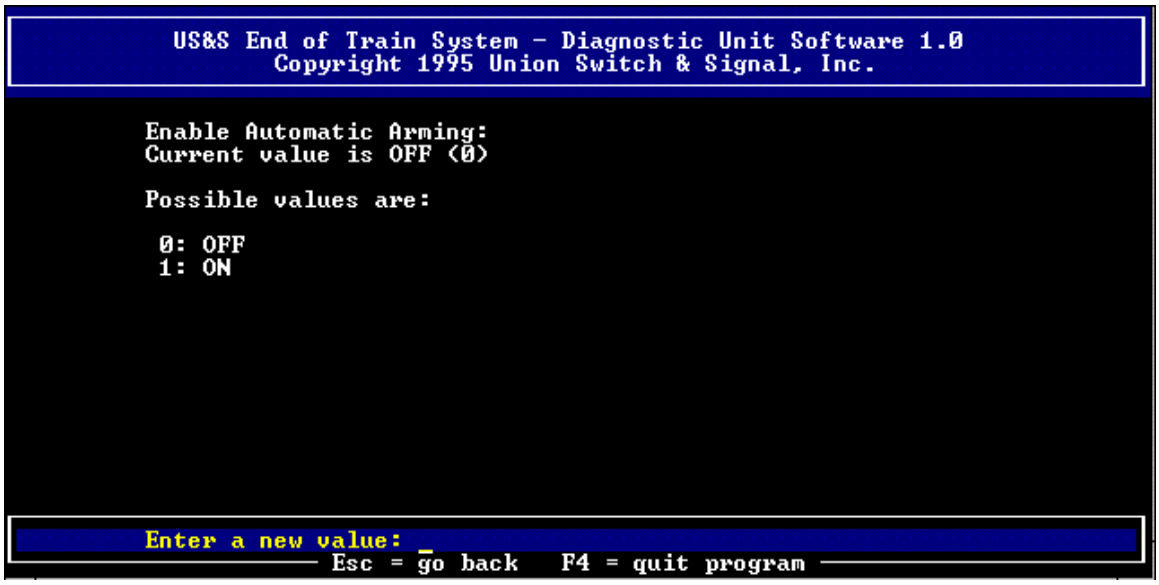
To enable or disable any of the menu items, type in the submenu item number and press <Enter>. Each submenu item will show the current enable/disable status. To enable or disable a particular menu item type in the numeric value for ON or OFF, respectively, and press <Enter>.

Press the <Esc> key to return to the next higher level configuration screen.

4.4.11 Enable Automatic Arming

For railroads who choose NOT to use the ARMING security feature, Automatic Arming can be enabled via this menu item. Enabling Automatic Arming, in effect, puts the CDU into an always armed mode. In this case, no operator is required at the rear of the train and the activation of the Emergency Switch will cause the transmission of an emergency brake command containing the currently entered ID Code.

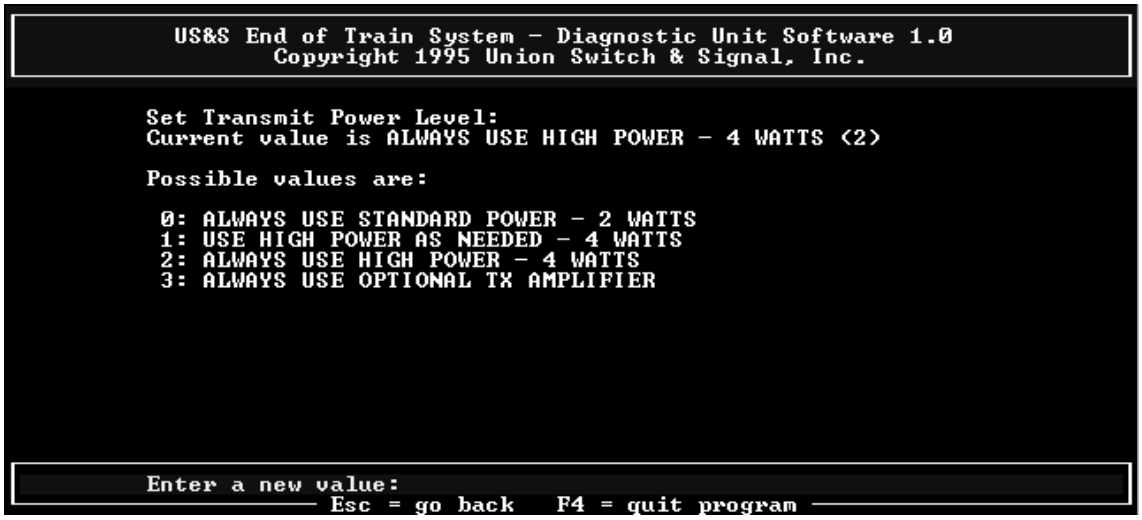
To view the current setting or to enable/disable Automatic Arming, select item “11” (Enable Automatic Arming) and press <Enter>. The following screen will appear:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Enable Automatic Arming:
Current value is OFF (0)
Possible values are:
0: OFF
1: ON
Enter a new value:
Esc = go back F4 = quit program

To enable or disable this function, type in the menu item number and press <Enter>. Press the <Esc> key to return to the Main Configuration Menu.

4.4.12 Set Transmit Power Level

The CDU normally transmits Emergency brake commands to the End Unit at 2 Watts RF power. The CDU has the capability to transmit at higher power levels as required by the Railroad. To select the transmit power level, type in “12” (Set Transmit Power Level) and press <Enter>. The following screen shows the currently selected setting:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Set Transmit Power Level:
Current value is ALWAYS USE HIGH POWER - 4 WATTS (2)
Possible values are:
0: ALWAYS USE STANDARD POWER - 2 WATTS
1: USE HIGH POWER AS NEEDED - 4 WATTS
2: ALWAYS USE HIGH POWER - 4 WATTS
3: ALWAYS USE OPTIONAL TX AMPLIFIER
Enter a new value:
Esc = go back F4 = quit program

The factory default setting is typically “0” for the 2 Watt power level. The transceiver module in the CDU supports transmissions at 4 Watts as deemed necessary by the Railroad.

NOTE

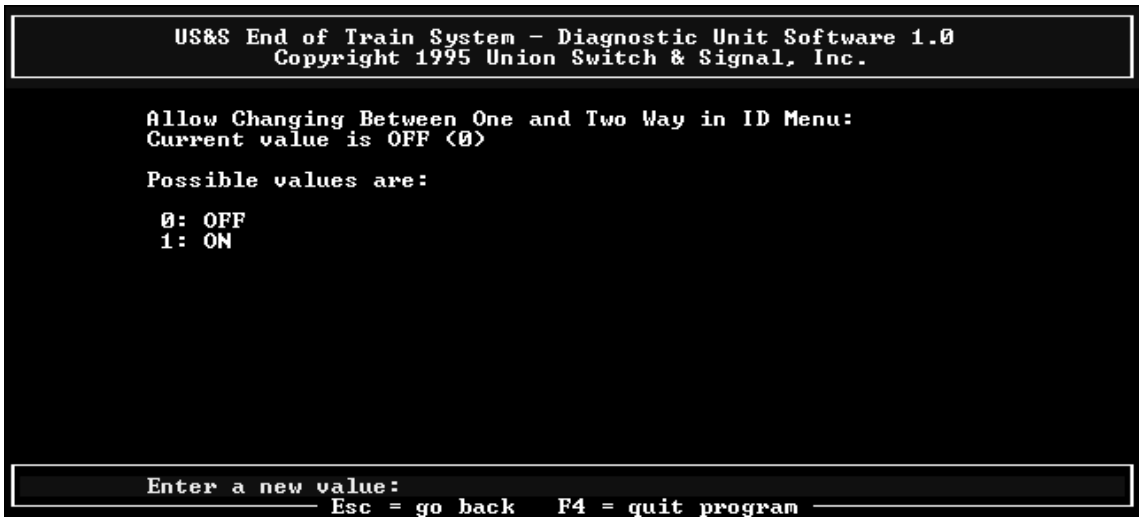
Setting and using the CDU at transmit power levels above 2 Watts may require licensing from the FCC.

Some Railroads require the capability to transmit at power levels higher than 4 Watts (e.g., 8 Watts). In this case, the CDU can be equipped with an optional TX Amplifier module.

To change the transmit power level setting, type in the menu item number and press <Enter>. To return to the Main Configuration Menu, press <Esc>.

4.4.13 Allow Changing Between One and Two Way Operation

The CDU has the capability to operate in either one-way or two-way mode. If this configuration item is set to ON, the CDU will prompt the user to select the operational mode immediately after a new ID Code has been entered. If the value is set to OFF, the CDU will not prompt the user and will simply save the new ID Code and operate in two-way mode at all times. To enable or disable this feature, type in “13” (Allow Changing Between One and Two Way in ID Menu) and press <Enter>. The following screen shows the currently selected setting:

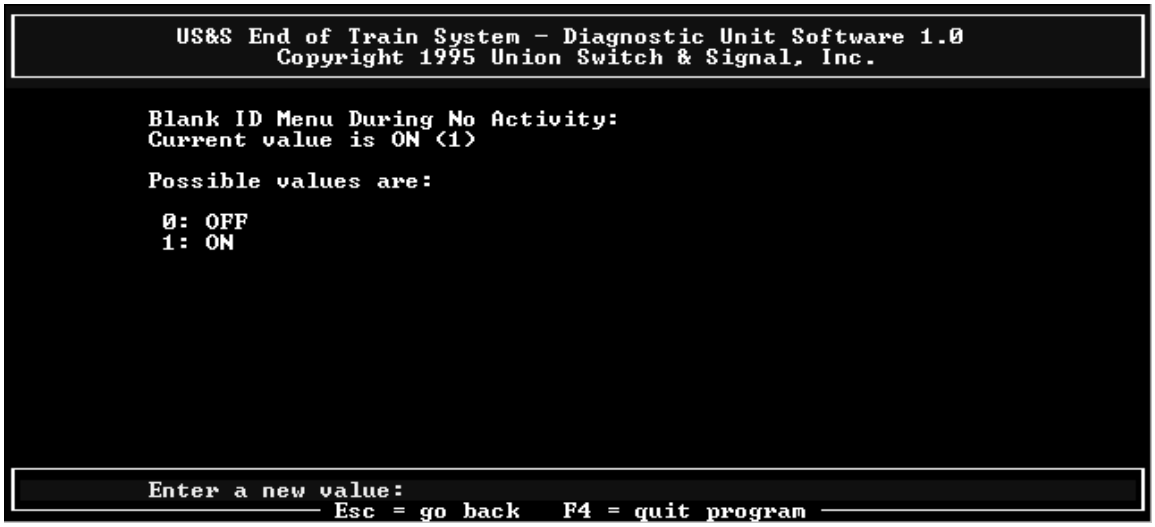

US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Allow Changing Between One and Two Way in ID Menu:
Current value is OFF (0)
Possible values are:
0: OFF
1: ON
Enter a new value:
Esc = go back F4 = quit program

To change the operational mode, type in the menu item number and press <Enter>. To return to the Main Configuration Menu, press <Esc>.

4.4.14 Blanking the Function Menu Display During No Activity

This configuration item is only applicable when the CDU's Change ID Menu Item is being viewed. If this configuration item is enabled, and none of the CDU's **Function Keys** are pressed for a period of 2 minutes, the CDU will display the currently entered Customer String (e.g., ABC Railroad) for 2 minutes and will then blank the **Function Menu Display**. This has been provided to reduce distractions to the locomotive operator.

To enable or disable this feature, type in "14" (Blank ID Menu During No Activity) and press <Enter>. The following screen shows the currently selected setting:


US&S End of Train System - Diagnostic Unit Software 1.0
Copyright 1995 Union Switch & Signal, Inc.
Blank ID Menu During No Activity:
Current value is ON (1)
Possible values are:
0: OFF
1: ON
Enter a new value:
Esc = go back F4 = quit program

To change the operational mode, type in the menu item number and press <Enter>. To return to the Main Configuration Menu, press <Esc>.

A.1 CDU Software Upgrades

The CDU uses a FLASH type programmable non-volatile memory chip to store its application software as opposed to a standard EPROM. This eliminates the need to disassemble the unit and physically replace the EPROM in the event that software upgrades are issued.

Software upgrades are supplied by US&S on a **CDU Executable Software Disk** containing two files; (1) the latest upgrade version of the CDU executable software named **"cdu.hex"**, and (2) the Cab Unit Flash Loader program named **"load.exe"**. This is a 3.5" disk and is available under US&S part number N451232-1633.

Software upgrades are downloaded into the CDU's Flash memory from a PC connected to the CDU's rear mounted DIAG connector via the same 9-pin "D" type serial cable used for performing diagnostics. The download function is performed by running the Cab Unit Flash Loader Software as detailed in the following sections.

A.2 Cab Unit Flash Loader Program

The Cab Unit Flash Loader program is named **"load.exe"** and runs on a DOS compatible PC.

Although this program may be run from the floppy disk drive, it is preferable to copy it to a directory on the PC's hard drive. The new Upgrade Version of **"cdu.hex"** must reside on same the floppy disk or hard drive directory containing **"load.exe"**.

A.3 Using "load.exe"

At the PC DOS prompt, the command syntax for "load.exe" can be viewed by typing in **load** followed by **<Enter>**. The PC will display the command structure as follows:

Cab Unit Flash Loader (REV 1) Thu Jul 18 16:11:41 EDT 1996

Usage:
load -<serial port> <filename> [-r]
where
-<serial port> is -COM1 or -COM2
<filename> is the executable to be loaded
in Motorola Exormax format.
-r means run the program after loading (optional)

Use a straight-through cable from the PC to the Unit.

Therefore, the typical command line, depending on the PC serial port being used, will be:

load -COM1 cdu.hex -r <Enter> if PC serial port 1 is being used;

or

load -COM2 cdu.hex -r <Enter> **if PC serial port 2 is being used.**

A.4 Procedure for Downloading CDU Software Upgrades

To download CDU software upgrades, perform the following:

1. On the PC, copy the new Upgrade Version of the file **"cdu.hex"** to the floppy disk or hard drive directory containing the Cab Unit Flash Loader Software **"load.exe"**.

2. Turn OFF power to the CDU.

3. Connect one end of the serial cable to the CDU's DIAG connector and the other end to one of the PC's serial ports (either COM1 or COM2).

NOTE

The CDU's DIAG port is permanently set up for 9600 baud, 8 data bits, 1 stop bit, and no parity. Set the PC serial port accordingly.

4. Turn ON power to the CDU. The CDU will automatically detect the presence of the serial cable and indicate it is ready for Flash download by displaying **"8.8.8."** on the Brake Pressure Display with all other displays turned OFF.

5. On the PC, enter the **load** command for the Cab Unit Flash Loader as follows:

   load -COM1 cdu.hex -r <Enter> if PC serial port 1 is being used;

   or

   load -COM2 cdu.hex -r <Enter> if PC serial port 2 is being used.

   The PC will display the progress of the download process as follows:

   Cab Unit Flash Loader (REV 1) Thu Jul 18 16:11:41 EDT 1996
   Press a key at any time to quit this program.

   Initiating target diagnostics:
   Cab Unit Boot Prom (REV 1) Thu Jul 18 9:37:47 EDT 1996
   ROM test PASSED
   RAM test PASSED

   Erasing flash ... done.
   Writing to flash ... #### records downloaded.

6. Upon completion of the download, the CDU will begin running the new upgrade software in the normal fashion just as it does on standard power-up.

7. Verify that the correct software revision is displayed on the CDU's Function Menu Display during the self test power-on sequence (e.g., "Version: REV 1").

8. Unplug the serial cable from the DIAG connector. The CDU is now ready for operation.